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America's Biggest Submarine Commissioned

V-1, *a Diesel-Driven Underwater Cruiser of* 2,164 *Tons and* 6,500 *s.h.p. Placed in Service—Can Maintain Speed of Battle Fleet*

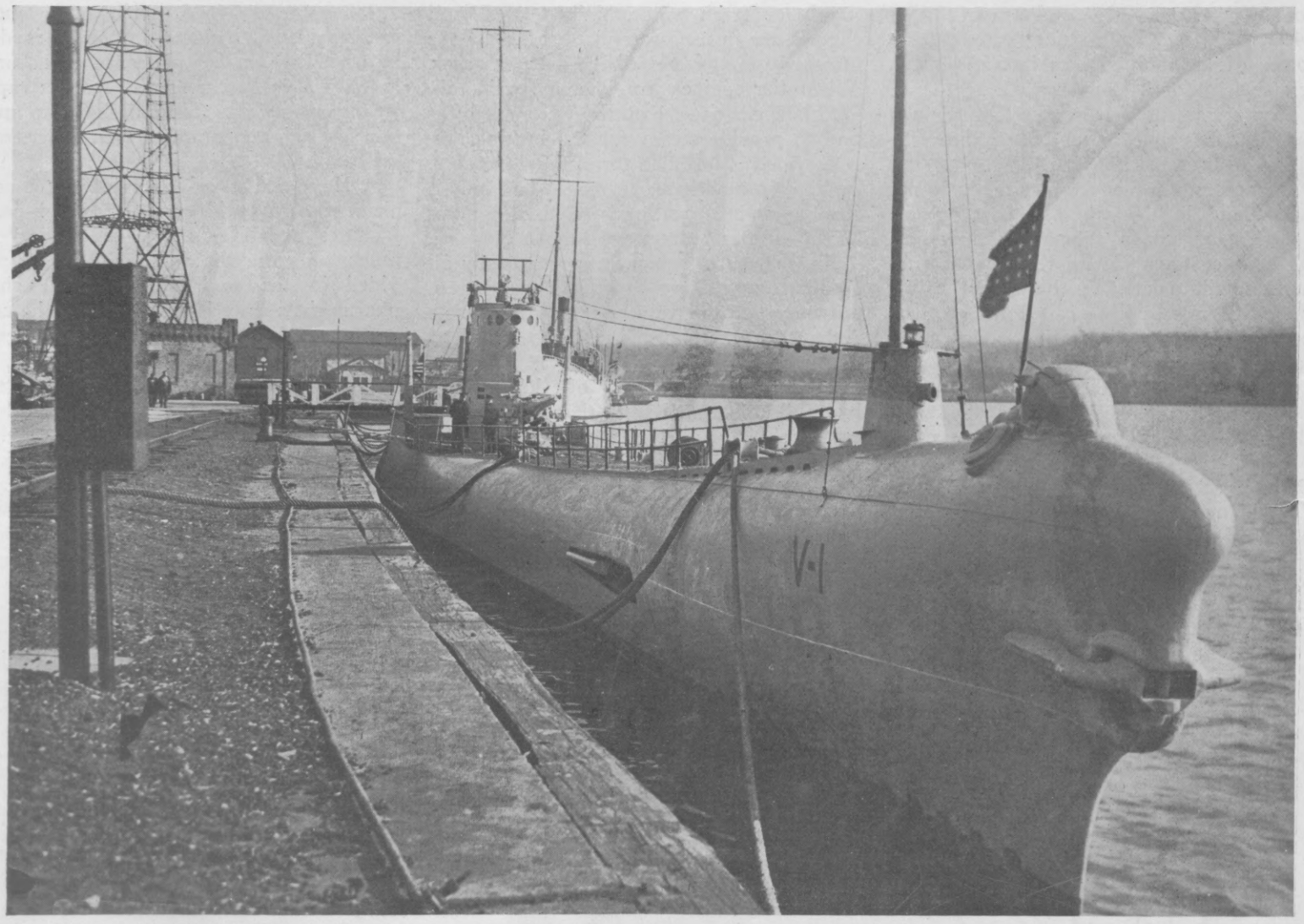
NEW submarines, particularly of the big cruiser type, are badly needed to properly balance the U. S. Navy, and to give it craft of equal or larger power and tonnage to the latest of other great navies. There is a tendency in Congress today to recognize this need and to provide funds for their construction, despite the strong wave of economy met everywhere in Washington and insisted on by Budget-Director Lord. A powerful, up-to-date underseas navy not only will form a valuable part of the defenses of our coasts and insular possessions, but will prove a deadly weapon against enemy fleets.

The V-1, first of the three cruiser-submarines building for our navy, was recently commissioned. This boat, it may be recalled, was launched on July 17th last at the Portsmouth navy yard, and is now in service. She is twice as large as the biggest submarine which has ever been previously built in the United States, and is the largest vessel constructed and launched at the Portsmouth navy yard since the Civil War. Nine of these fleet submarines were authorized by the Act of Congress of August 29, 1916, but only three have been laid down as yet. The V-1 was laid down on October 20, 1921. Work on the V-1 was much curtailed during the years 1922-23, owing to lack of funds.

This craft has been designed primarily to accompany the Fleet at sea in any weather and to maintain any speed of which the Fleet itself is capable. The following are her principal characteristics:

Length, over-all	341′ 6 ″
Breadth, maximum	27′ 6⅝″
Displacement, surface	2,164 tons
Speed, Surface	21 knots
Speed, Submerged	9 knots
Total Power	6,500 s.h.p.

The vessel is propelled by four Diesel engines, two of which are connected directly



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First of the U. S. Navy's submarine cruisers, the V-1, just commissioned. Sufficient Diesel power is installed to enable her to keep up with the battle fleet

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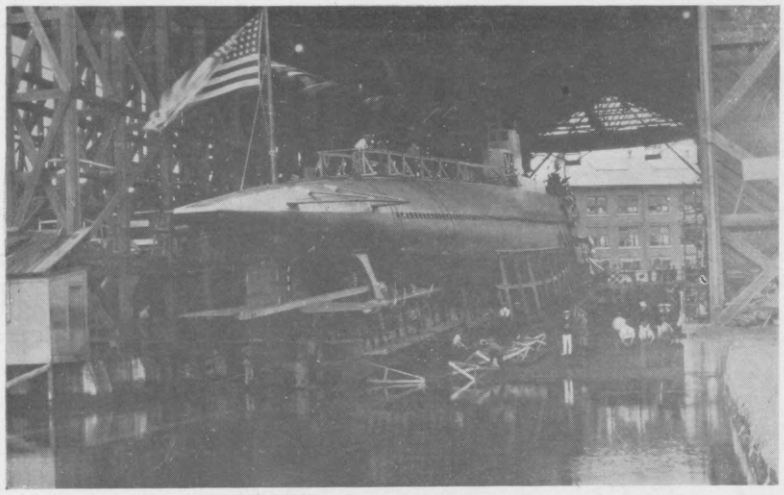
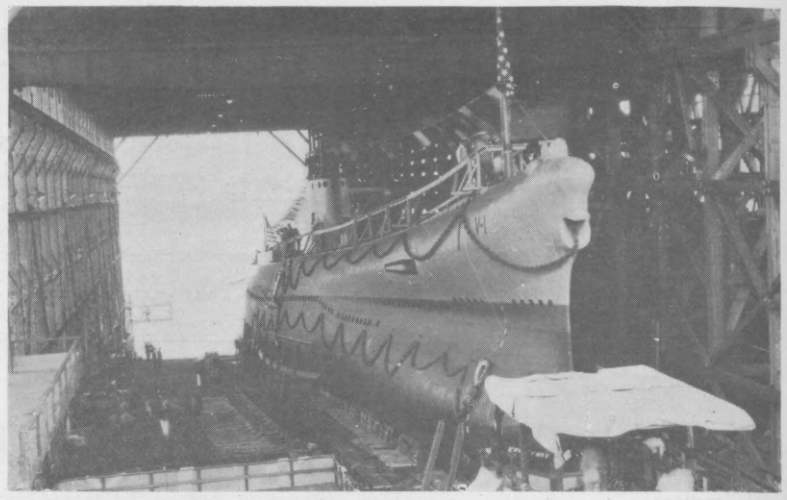




Stern and bow views of the V-1 on the stocks prior to launching last summer clearly show her underwater form

to the propeller shafts by friction clutches, and two of which are connected indirectly by an arrangement of electric drive similar to that now standard for all capital ships of the United States Navy. By this means, either pair of engines may be used alone to drive the vessel at slow or moderate speeds and both pairs may be used when high speeds are required. The forward or electric-drive engines are of the Bureau of Engineering's four-cycle type manufactured by the Government at the New York navy yard, and based on the M.A.N. design. The after or mechanical-drive engines are of the Sulzer two-cycle type, built by the Busch-Sulzer Bros. Diesel Engine Co., of St. Louis, Mo., and are of 2,250-2,400 s.h.p. each. The total rated horsepower of all four engines is 6,500 b.h.p., or sufficient for 21 knots speed.

Her armament consists of six 21-inch torpedo tubes, one 5-inch, 51 calibre rifle and two Lewis machine guns.

On account of her large size, it is not likely that the V-1 when in port will be secured alongside a submarine tender, as has been customary with the smaller submarines built to date. Furthermore, the duty which this vessel will be called upon to perform will necessitate cruising under much more exacting conditions than have formerly obtained, and for these reasons the V-1 and her sister ships have been provided with additional facilities to render them comfortable and to the fullest extent self-sustaining.

Many new features have been adopted, following standard practice on battleships, light cruisers, destroyers and other surface vessels. These new features have been made possible by the increase in size of the vessel, by careful design and extensive development to meet the particular needs of the submarine service.

To provide for communication with the shore and other vessels, two boats are carried, one a Navy standard 24-foot whaleboat, and the other a standard 24-foot motor-launch. The engine of the latter boat is of the latest type and is provided with a watertight metal cover, designed to withstand sea pressure when the vessel submerges. Two special derricks with power winches will hoist these boats in and out of the water and the customary boat-booms and gangways will be fitted as on larger vessels.

Provision has been made for an ample supply of fresh water. When the Diesel engines are in use, water is distilled by the utilization of the heat of the exhaust gases. When the engines are idle, a special oil-fired boiler is used, both to evaporate water and to provide steam for the heating system, which is installed throughout the ship. For use in moderate weather, when only a small amount of heating is required, a number of electric heaters are supplied.

As is usual in submarines, practically all auxiliary machinery is electrically driven, but many of the valves, radio-mast hoists and other mechanisms are operated by means of hydraulic power.

The steering gear is of the electro-hydraulic type, similar to that used on the capital ships of all the larger navies of the world.

The ventilation system is much more extensive than that fitted on any previous United States submarine and all the details concerning renewal of air in compartments when the vessel is on the surface, circulation and purification of the air when submerged, drying and cooling of the air and revitalization by the addition of oxygen have been carefully worked out.

Berths in small staterooms have been provided for seven officers. There is a wardroom for meals and recreation and food is provided from a separate officers' galley. The latest design of metal furniture has been fitted throughout the officers' quarters, in order to provide more sanitary arrangements and to guard against fire risk.

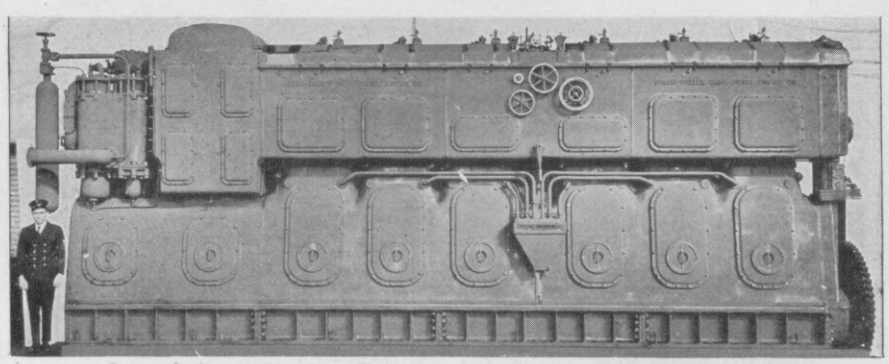
Every member of the crew of eighty is assigned a comfortable berth and a locker of sufficient size to stow all his effects. The washing and sanitary facilities provided for the crew are the equal in all respects of those fitted on modern surface vessels.

The galley and food storage arrangements are unusually complete. Cooking is done by electricity on hot plates, in ovens or in special kettles. Ample cold storage capacity is provided and this is designed to maintain freezing temperatures even under tropical conditions.

A Navy mail-clerk is carried in the complement, so that the crew may enjoy postal facilities at all times. The medical arrangements are the best that can be provided in the available space. A chief-pharmacist's mate is a member of the crew and an ample supply of medicines and surgical appliances carried.

A wooden deck, consisting of narrow strips with spaces between, is laid over practically the entire length of the vessel, in order to provide a secure foot-hold for the crew and to minimize the effect of seas breaking over the side, a condition which generally obtains on vessels such as submarines, which have such comparatively small free board. A portion of the bridge is inclosed, to serve as a pilot-house for the steersman and a shelter for the personnel on watch in inclement weather. Awnings for the bridge and for the deck are provided for use in tropical waters.

The fuel capacity, provision allowance and repair facilities on board are such that the V-1 can make any voyage of which the Fleet as a whole is capable.



One of the 2,400 s.h.p. Busch-Sulzer Diesel engines of the V-1

KURENAI MARU, a 1,550 tons gross Japanese liner with accommodations for 508 passengers, has been placed in service by the Osaka Shosen Kaisha. Twin 1,150 i.h.p. at 150 r.p.m. Burmeister & Wain Diesel engines drive her at 13¾ to 15 knots.

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Krupp's Big Battleship Diesel Engine

Series of Experimental Engines Leading up to Final Design and Completion of a Six-Cylinder 12,000 s.h.p. Two-Cycle Set Yielded a Wealth of Engineering Information

By DR. LANDAHN

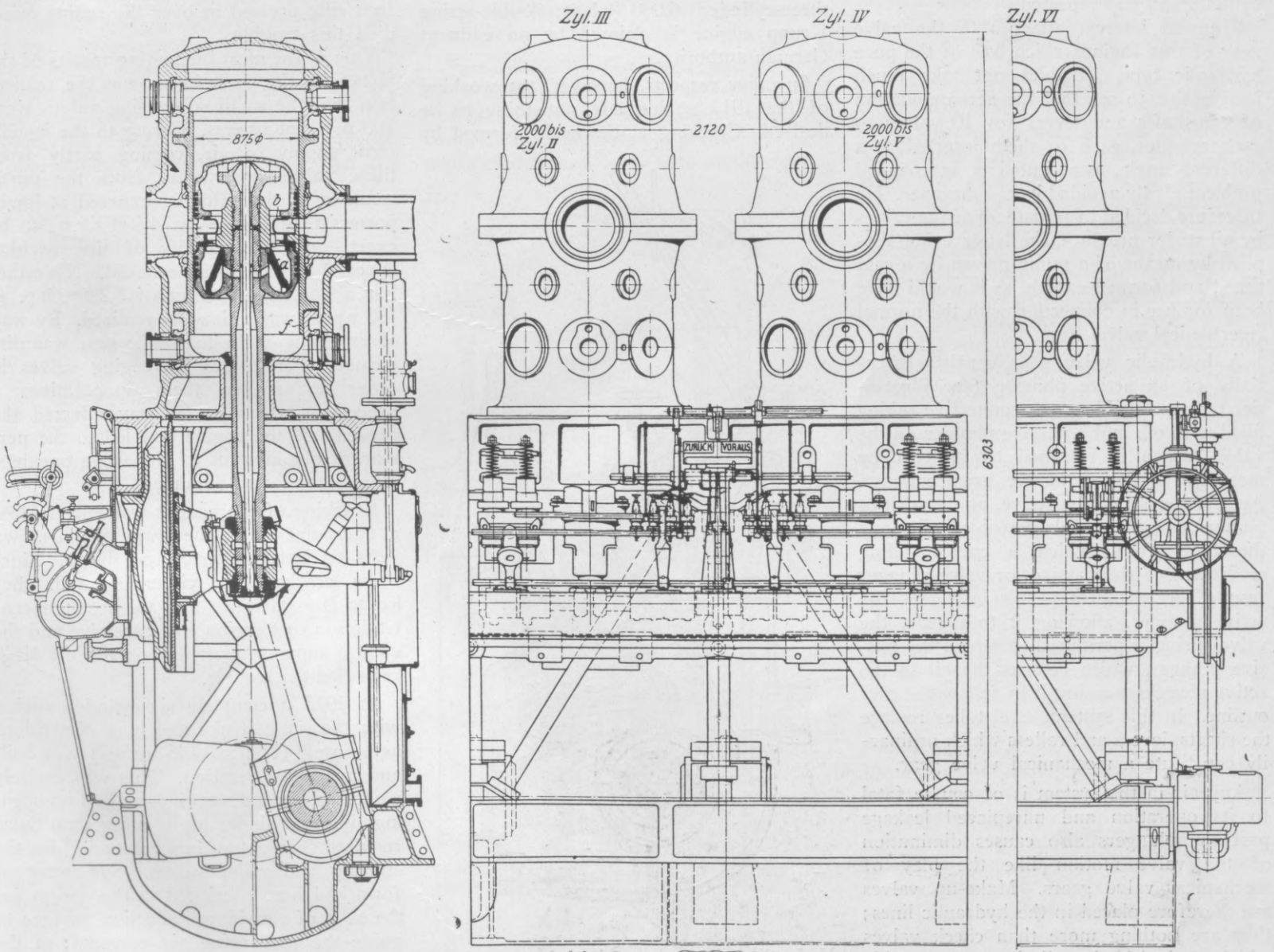
AS early as 1911, when the German naval administration authorized two prominent builders — M.A.N. and the Krupp Germaniawerft—to proceed with the development of 12,000 h.p. Diesel engines for battleship drive, the vast possibilities of this new type of prime mover were already realized. The foresight of the German government is of the greatest value today in merchant motorship construction.

Progress with these two large Diesel units was hampered by the outbreak of the World War and all German naval engineering efforts were bent to the production of a Diesel engine of an entirely different character, the U-boat type. Nevertheless, relatively rapid advances were made with the high-power double-acting engine, as the readers who followed the series of articles which appeared in MOTORSHIP a year ago will recall. The engine which was there described was the product of the Augsburg plant of the M.A.N.; and although the impression may have become current that this is the only firm which was thus engaged, it is nevertheless true that a second firm—the Krupp Germaniawerft of Kiel—made equally strenuous efforts to produce a workable Diesel engine of the double-acting two-cycle type capable of developing 12,000 s.h.p.

For Krupp's original experimental engine only one cylinder was built and it was expected to yield 2,000 s.h.p. with bore and stroke dimensions of 34.45 x 41.34 inches. Owing to the occurrence of a critical speed at 108 r.p.m., which made it impossible to run at higher revolutions, and to an insufficient supply of injection air, it was impossible actually to develop more than 1,510 s.h.p. during the test with this engine. During another test at 110 r.p.m. the engine shaft broke between the flywheel and the main bearing; subsequent examination showed that extremely poor foundations had allowed the engine to settle and that it had been thrown seriously out of alignment while running.

Since low weight per horsepower is an essential requirement for naval work, the open-type steel-column construction characteristic of high-speed destroyer engines was selected. It consists essentially of a bedplate separated by means of forged-steel framework from an entablature, on which latter the cylinders are mounted, and was retained througout the entire range of experiments with varying cylinder designs.

Naturally the greatest interest centers on the cylinders, as indeed corresponds to the fact that the place where trouble first became manifest was in the cylinders and cylinder heads. Four separate castings comprised the water jacket, the two central ones accommodating the exhaust passages. The two extreme cylinder jacket castings have pressed into them the thin shells comprising the actual liners and the top and bottom cylinder heads are placed inside the cylinders. Neither studs nor bolts are used for fastening the cylinder heads; that they rest against shoulders against which they are urged by the gas pressure; and that they must be inserted before the upper and lower cylinder ends are assembled. This principle of avoiding



12,000-shaft horsepower double-acting two-cycle Diesel engine built by the Krupp Germaniawerft during the War. The design illustrated here is the last one of the series of experimental engines

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all forms of screwed fastenings in the design of the cylinder heads and liners, was adhered to throughout the entire series of experimental constructions.

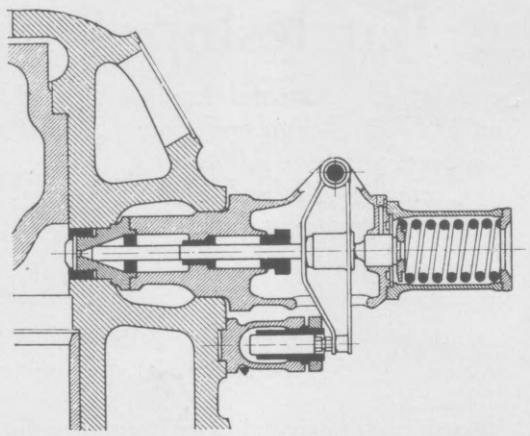
Valve scavenging not unlike that of the earlier M.A.N. engines was employed for the 1911 single cylinder machine, a design which entailed complicated pocketing of the extreme ends of the water jackets and precluded the use of regular, symmetrical forms for the cylinder heads. Owing to the limitations of power output already referred to and to the termination of the tests with this engine as the result of the crankshaft breakage and misalignment described above, there was no real opportunity to ascertain the operating characteristics of the valve scavenging construction.

The overall results from the single-cylinder engine were such as to justify further experimentation and in July, 1912, a three-cylinder valve-scavenging engine rated at 6,000 s.h.p., and embodying no radical departure from the foregoing design, was ready for starting up. Since the liner of the single cylinder had cracked near the upper end, the second machine was built without any separate cylinder liners at all, the piston working directly in the integral cylinder casting. The use of four scavenging valves and two fuel valves in each cylinder end was repeated.

Unusual interest attaches to the valve gear of this engine, which was of the pure hydraulic type. It does not take much imagination to see that the accommodation of camshafts and levers for 10 valves to each cylinder, each of them inserted at a different angle, constituted a mechanical problem gladly avoided by the designer. He therefore decided to actuate all of the valves by oil under pressure, the latter being supplied by means of a pump driven by a cam timed and formed exactly as it would have been for use in connection with the normal mechanical valve drive.

A hydraulic valve gear consists essentially of an active plunger (see illustration) moved by the cam, connective tubing filled with oil, and a passive plunger on the valve, which is returned to its seat by means of a spring in the usual manner. Any movement of the active, or cam-driven plunger causes a displacement of oil along the tube, from which a corresponding movement of the passive, or valve plunger results. As the cam passes on under the active plunger, allowing it to recede, the valve-spring is permitted to return the passive plunger, which returns the oil to the active plunger, causing it to follow the cam outline. In this system, steel tubes replace the shafts. levers and rollers which ordinarily constitute a mechanical valve gear.

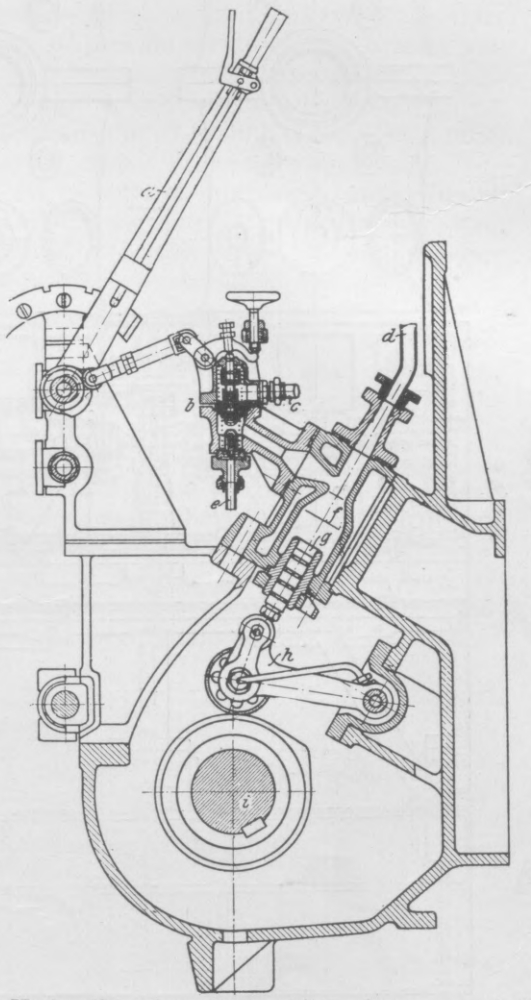
Any air in the system is of course fatal to its operation and unreplaced leakage past the plungers also causes diminution of the valve motion like the play of mechanical valve gears. Make-up valves are therefore placed in the hydraulic lines; they are nothing more than check valves which replenish the oil from an outside supply whenever its volume becomes less



This hydraulically operated fuel valve is raised off its seat by oil under pressure acting on the small plunger

than that of the system in which it works. In order further to insure against vacuum being formed and to prevent the entrance of air in a positive manner, the supply to the replenishing checks is put under pressure from a small pump driven from the engine. It has a spring-loaded overflow valve which prevents the pressure of the make-up oil from rising beyond the point where it could move the valve plungers independently of any motion on the part of the active plungers. That this system worked excellently in connection with the three-cylinder 6,000 s.h.p. double-acting Krupp engine is claimed by an eminent German authority.

In other respects, however, the working of the 1912 engine left something to be desired. Cracking at the necks formed by the intersection of the scavenging valve pockets and the combustion space was so serious a factor that it compelled the replacement of the cylinders.



Hydraulic valve gear consists of cam-operated plunger and oil tubing instead of rocker levers, etc.

Owing to insufficient confidence on the part of the designers in the efficacy of port scavenging, a complete elimination of the scavenging valves and their pockets was not resorted to in the next design (1913-1914); rather a combination of port and valve scavenging was adopted. In addition to the scavenging ports, four scavenging valves of greatly reduced diameter were now employed. An improvement was thus effected, but it became apparent, also, that complete success would be unattainable as long as the integral construction of liner and jacket would be retained.

As the result of these considerations the cylinder liner and combustion space were again made in separate pieces and a cylinder head with a dome-shaped interior was produced; the latter resting against the closed end of the water-jacket casting. Cast-iron, bronze, cast-steel, and cast nickel-steel were used for these dome-heads and of the four, the nickel steel manifested the least tendency to crack. With the others, cracks occurred in the lower head at the neck formed by the intersection of the stuffing-box neck with the crown. A cast iron ring pressed in over the radius remedied this trouble.

One of the most interesting results of the tests with the dome-heads was the realization that the small scavenging valves were 100 per cent useless. Owing to the insufficient supply of air, coming partly from these valves and partly from the ports, smoking of the exhaust occurred at lower powers than before—at 4,500 s.h.p., to be exact—and the capacity of the machine appears to have been reduced. Nevertheless a maximum output of 5,280 s.h.p. at 150 r.p.m. was ultimately realized. By way of experiment, the hydraulic gear was disconnected from the scavenging valves in order to render them inoperative, a procedure which in no way affected the capacity of the engine and led to the permanent blanking-off of the valve openings with water-cooled dummies.

Cracking of the pistons was encountered at the point where the lower piston crown rests against the piston-rod flange. Since these cracks were circumferential, they led to the inference that the load concentration in that region was excessive and the conical support marked *a* on the drawings remedied the trouble.

In 1915 a complete six-cylinder engine with the same stroke and bore dimensions as before (41.34 x 34.45 inches) was built and put into operation. This was entirely a port scavenging machine and had no openings in the cylinder heads other than those required for the two fuel valves and for the starting and relief valves. Symmetry of form had been sacrificed in the design for the sake of providing deflection surface to guide the scavenging air currents; at the same time the recesses which were thus produced served as a part of the combus-

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tion chamber. Circumferential cracking of the lower ends of the cylinder liners at the point marked *f* was eliminated by making that portion of the liner which extended below the liner flange as a separate ring; in other words, by artificially producing the crack in advince of its natural occurrence, and thereby preventing it from spreading to vital regions.

Many minor accidents and disturbances, such as cracking a lower cylinder head by a loosened spray-valve nozzle and the damaging of the entire engine by a sudden stoppage of the cooling-water supply, continually postponed the day on which tests under full load conditions could be run. Compressor troubles were finally disposed of by the purchase of independent compressors each driven by a six-cylinder four-cycle Diesel engine of 1,000 s.h.p.; this is an interesting commentary on the size of the engine under experimentation.

The actual full rating of 1,200 s.h.p. was actually attained for a period of one hour, in the course of which mean pressures of 103.1 and 78.9 lbs. per sq. in. were indicated in the top and bottom cylinder ends respectively. A five-day run at a mean output of 10,600 s.h.p. was made with 98.1 and 73.4 as the values for these figures, while the fuel consumption amounted to 0.53 lb. per s.h.p. hour. It is hardly worth while to go into further details concerning the tests, in view of the fact that at the end of the five-day run five out of the six cylinders were found to have cracked around the stuffing-box and in other places. There appears to be little doubt that the engine was over-rated, particularly if the cubic feet of fresh air actually made available by the scavenging system employed are taken as a basis. The realization of this fact led to a series of highly-refined experiments for the purpose of determining a suitable port scavenging system. At the same time an entirely new design was laid down, in which the following requirements, as taught by previous experiences, were to be taken into account:

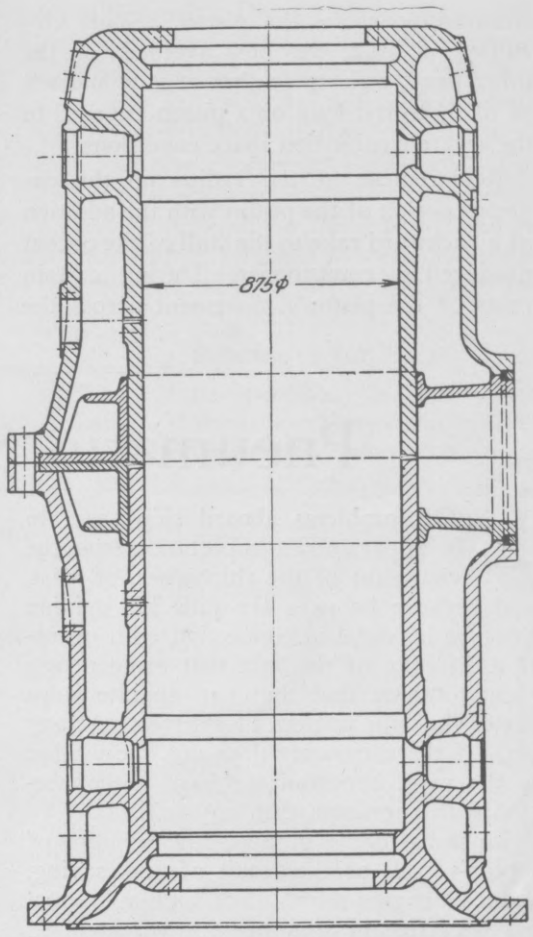
The abrupt transition between the lower head and the mouth of the stuffing-box must be avoided, since the neck of the latter remains cool while the rest of the head expands away from it.

Intersections at other places, such as the entrances to the fuel valve pockets require more intensive cooling, to be secured either by the use of new forms or of thinner walls.

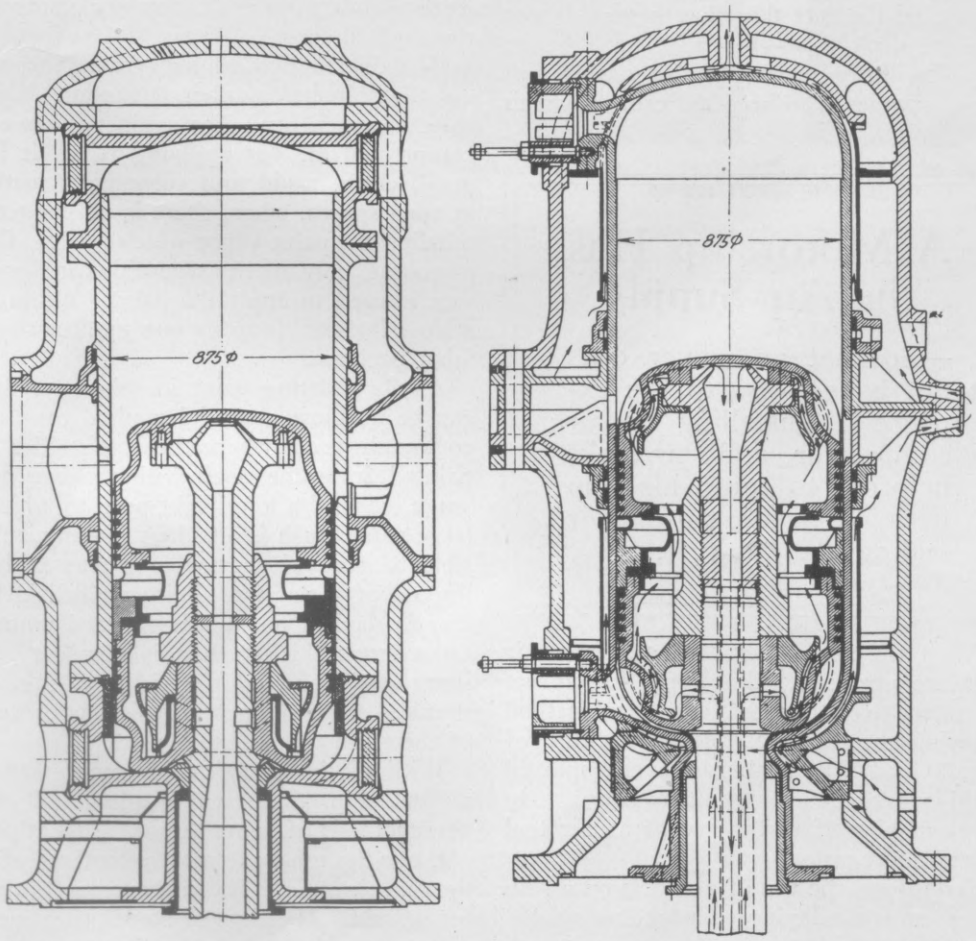
Avoidance of the submerged flange between the head and the cylinder liner.

Erosion of the piston surface by the fuel valve jet should be minimized by properly forming the combustion space, Higher power with good combustion to be secured as the result of a more careful working-out of the port scavenging method.

Particularly the last-mentioned phase of the design evolution—port scavenging—appeared to need careful study, with the result that elaborate experiments were made along these lines. One of the central



One of the experimental cylinders. Both valves and ports were used for scavenging



At left is shown the design actually yielding 2,000 s.h.p. per cylinder. Note separation of extreme lower end of cylinder liner from portion above flanged joint. The design shown at the right was never built because of the outcome of the World War

cylinder sections from the double-acting engine containing the exhaust and inlet ports was set up with a glass cylinder of 34.4" internal diameter set on top of it. A wooden cover of the same shape as that of the cylinder was fitted and a wooden piston was arranged to travel back and forth over the range of the ports by a suitable mechanism which imparted the same motion as that occurring in practice. Means for measuring the dynamic pressure of the air over a vertical plane was placed along a diameter at right angles to the centerline of the ports. In addition to that, wires with small streamers tied to them were strung across the cylinder and the entering air was saturated with sawdust to make its currents visible.

It was indicated by the first of the readings that appreciable velocities occurred only near the piston top and that they were highest in the "corners" near the cylinder walls. While there was practically a short-circuit across the top of this piston, a dead eddy, useless as far as scavenging effect was concerned, occupied the upper portion of the cylinder. This was the shape of ports and piston used with the six-cylinder 12,000-h.p. engine already described and it is easy to see that at least a part of the heat troubles encountered in it were due to sluggish and delayed combustion caused by insufficient air supply.

The fitting of a sharp deflector edge to the piston in place of the 7/8" radius previously employed, reversed the picture, producing a vertical upward travel of the air along the cylinder bore on the inlet side. After reaching the cylinder top the stream went across and down the opposite side to the exhaust port, leaving the dead eddy

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immediately above the piston. Short circuiting, at least, was now avoided; on the other hand, a sharp feather edge would not be likely to last long on a piston exposed to the severe combustion space conditions.

Replacement of the radius on the deflector pocket of the piston with the addition of a backward rake to the wall of the pocket produced a compromise. During certain parts of the piston's movement across the ports the overhead loop was produced, while near the bottom dead center short-circuiting again took place.

As between the overhead stream and the short-circuiting along the piston crown, the former would appear to be preferable in view of the fact that energetic flow towards the exhaust ports has already been initiated at the moment when the scavenging begins.

An extended study of the scavenging process occurring in the lower end of the double acting cylinder was also made, as the result of which the effect of the piston rod could be analyzed. As with the top end, it was found that the deflector edge of the piston was an important factor, which could make the air stream either hug the walls or short-circuit across to the exhaust openings.

Zeitschrift des Vereins deutscher Ingenieure, Nov. 8 and 15, 1924. Drawings by courtesy of Krupps.

Pneumatic Scaling Tools for Motorships

Efficiency of a Vessel's Deck Force Can Be Increased by the Permanent Adoption of Compressed-Air Equipment

By A. B. Newell

LABOR problems aboard ship seem to be of paramount importance, from the viewpoint of the shipowner, at least, and because he pays the bills his opinion must be of value in connection with operation, in spite of the fact that some people seem to think that they can operate ships better than the owners themselves. At any rate, if the shipowner does not know what is the most important problem in connection with operation, then no one does.

Much has been said about the economy of motor-vessels as the result of fuel saving, reduced engine-room force and additional cargo carried in place of so much fuel and water. As yet I have not seen any assertion that a motorship can get along with a smaller deck force than a steamship of similar size. This is the case, however, in the ships of certain companies, but not so in others.

In reducing the deck force, the machinery has had but little to do with the case, but that may change in favor of the motor-vessel. Some companies take a pride in the appearance of their ships, while others do not seem to care how their vessels look, as long as they load and sail and come back to load and sail again.

To those of the former class, this may make an appeal and it may also appeal to the latter class, for it treats with crew reduction, but it is not my intention to make any suggestion to this latter type of shipowner, for I have long since learned how futile it is. I have nothing in common with the owner of the "lime juice tramp," who fed his crew on Cape Horn soup, in which bottom could be seen in fifteen fathoms; fed his boilers on sea water, to increase cargo space, and discouraged the most enterprising Liverpool tailor from ever selling a suit of dungarees to a member of the crew, for the simple reason that no member of the crew ever had enough to buy new dungarees. Having nothing in common with him, I do not care to discuss the pound, shilling and pence question, for it seems he has made money.

I feel that the men who take a pride in their ships have perhaps lost some of the old traditions of the sea. I know that they do not place more men and better food aboard because they have a soft spot in their heart for the men; nor do they give more pay because they want to see the men have a better time ashore when they take liberty. They do these things because they feel that theirs is a better business policy, and having lost some of the old sea traditions they will not follow a method governed entirely by blind prejudice, bull headedness and an inherent feeling that a hundred dollars spent on repairs is cheaper than ten spent on wages.

On ship board chipping rust and scaling paint occupies a goodly portion of the time of the deck force, more especially on a ship which is commencing to show her age. The companies which keep their ships up well find it necessary from time to time to send them into a shipyard to have them scaled, in spite of the fact that they have a larger crew on deck than—for want of a better word, I will say conservative—the conservative companies who keep the crew down to a minimum.

A Motorship Has the Air Supply

—So that an owner does not have to go to the expense of installing an air compressor and air-tanks in order to equip his ship with pneumatic power for scaling and painting.

When the ship enters the shipyard, air tools are applied to the work, for as yet that seems to be the most economical method involving the least possible expenditure of labor. Good, skilled labor is never employed on this work, the average man being able to accustom himself to the use of an air tool in very short order.

Heretofore, the use of air tools on a ship at sea, or while laying at a loading or discharging berth, has never been given much thought, because the cost of installing air-compressors and tanks would naturally involve quite an expenditure, to say nothing of the fuel required to supply power for them.

On the motorship, the situation is altogether different, for the air compressor and tanks are a part of the regular engine-room equipment. The cost of installing air lines to all parts of the ship would shortly be more than covered in moving the ship to the shipyard, where air is available, to say nothing of time losses, which are expensive.

The average sailor spends a good portion of his time at sea wielding a chipping hammer, which is slow work, but very necessary. With an air tool, this same man could do four times as much work and three other men could be released to do other work of importance.

With the work at sea well in hand, the men could be placed over side and everything scaled from the water-line up, while the ship lay in port from time to time, just as the ship's sides are commonly painted by the crew in port.

The distribution of air outlets throughout the ship has another advantage, for in spite of much prejudice against the use of compressed air for applying paint, it is a good, clean, rapid and economical method in open spaces, where there is no danger of inhaling the paint vapor which arises. This, of course, only applies where the proper device is used to apply the paint. Again the ratio of about four to one applies to the labor problem.

As for wasting paint in this way, there can be no more wasteful method than that commonly used, where the ship's sides are painted from the dock with the use of a "man helper," a long, light pole, to which a large paint brush is attached, making it possible to reach inaccessable places without the aid of a staging. Paint applied in this way is daubed on in a haphazard manner, often much thicker than is necessary. A survey of most ship's sides will reveal streaked and run spots, serving as evidence of the truth of this statement.

With the introduction of compressed air aboard ship, there will gradually develop new methods of doing things. Just at present, our thoughts are mostly centered about the machinery and its improvement on motor vessels. The time of standardization of motors to a few of the leading types is not far distant. Once standardization has taken place as it has long since in steam,

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then our thoughts will turn to other devices entirely different from those on the old-fashioned steamship and things unheard of aboard ship today will be of a commonplace nature a few years hence.

As just one example, I venture to state that many a steam-driven tank-ship which has been wrecked in the past would have been saved if she had aboard the same means of holding herself afloat with compressed air that motor-tankers will have ten years or less from now.

There is no need of a tankship sinking for want of a bottom, if she has a good deck and tank tops and sufficient supply of compressed air aboard to hold back the water. However, this is beyond the present subject.

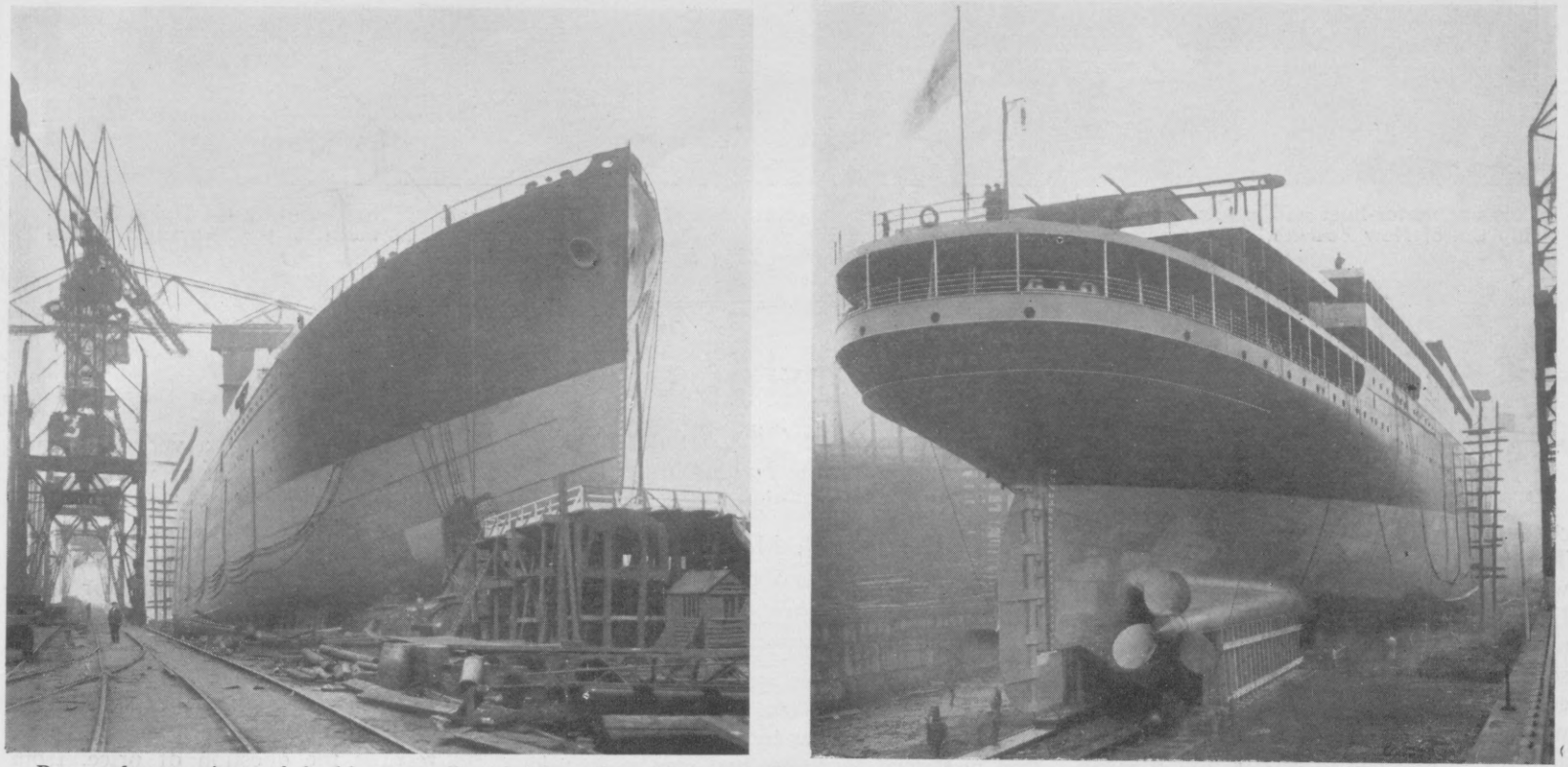
The possibilities of keeping up the ship's appearance by using available air should appeal to the owner who takes a pride in his ship, and the possibility of reducing the deck force should appeal to the other type who does not care how his ship looks, but feels sick each time he has to 'phone the shipping commissioner to go down to the dock and pay off.

Oil-Engined Harbor Work-Boat

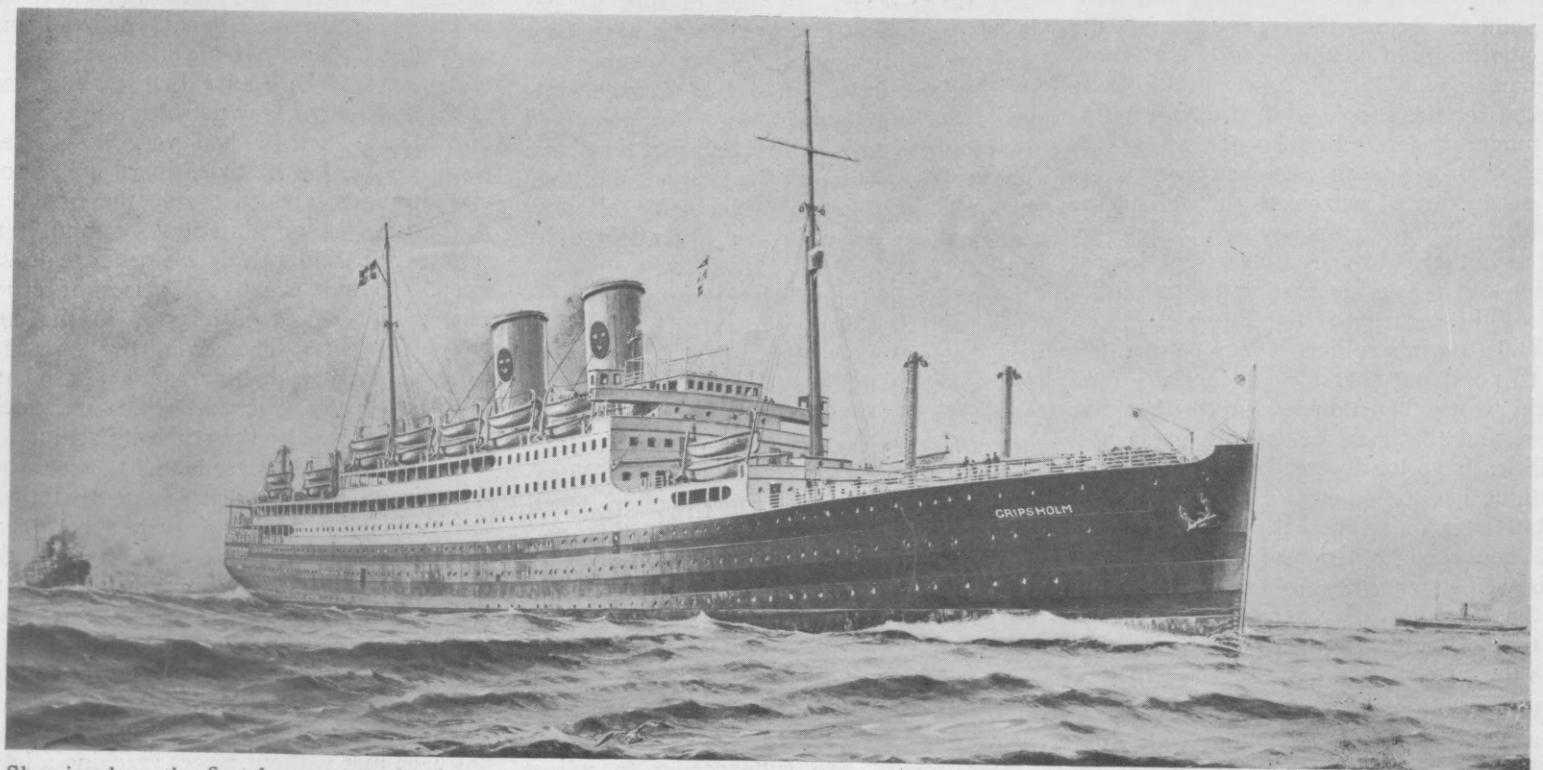
A work-boat of business-like appearance and fitted with a 120-b.h.p. direct-reversible Nelseco Diesel engine, was recently put into the service of the Merritt-Chapman & Scott Corporation of New York City, who are using her for carrying water and supplies to their dredges. Owing to the fact that she carries an 8,000-gallon tank and is well equipped with derricks, she will make a handy boat for this purpose and her economical oil engines will effect big savings for her owners in the matter of fuel bills.

Big Submarine for Brazil

Bids will be opened on May 25 by the Brazilian Minister of Marine on a 1,300 ton Diesel-driven submarine.



Bow and stern views of double-acting Diesel-driven liner "Gripsholm" on the stocks at the Armstrong Whitworth yard, Newcastle, prior to her recent launching



Showing how the first large transatlantic passenger motor-liner will appear next June when she crosses the ocean on her maiden voyage. Twin 8,150 i.h.p. B. & W. double-acting Diesel engines will propel this magnificent ship

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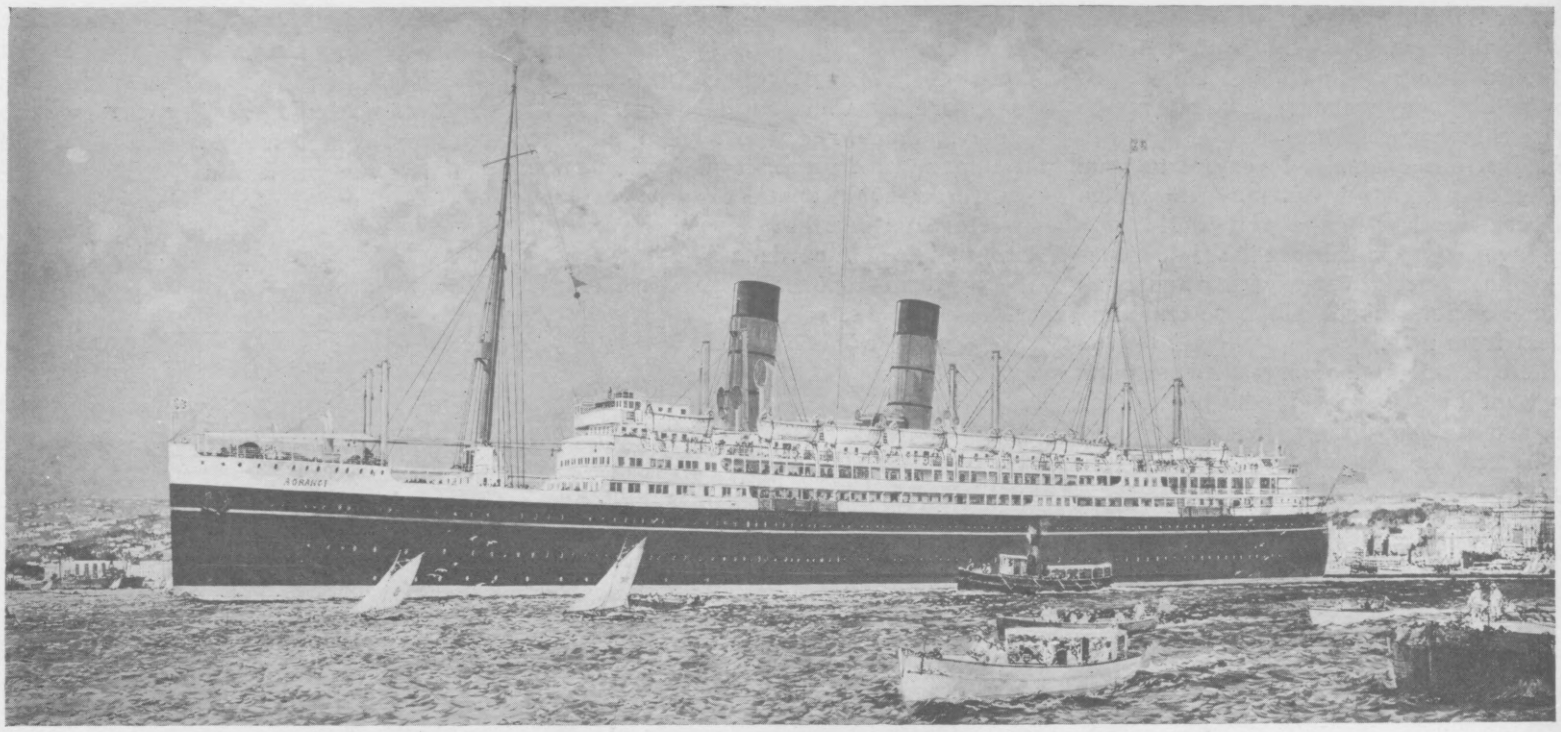

This fine motor-liner will have run trials by the time this appears in print. She will be operated on the Pacific Ocean by the Union Steamship Co. of New Zealand, and is propelled by four Sulzer Diesel engines of 3,475 s.h.p. each. A huge steel model of the "Aorangi" can be seen at the offices of Norton Lilly & Co., New York

Oil Fuel for Motorships of To-morrow

A Great European Oil Company Gives Its View of the Future Supply Situation

By J. J. McPhie

Manager, Fuel-Oil Dept., Asiatic Petroleum Co.

THE question of supply of fuel-oil for Diesel engines has become a matter of very great interest to shipowners who contemplate building oil-engined vessels. The fact that at the present time the new vessels building are to a very large extent Diesel-engined proves conclusively that the majority of owners have satisfied themselves that not only is this type of vessel an economical and suitable one, but that they will be readily able to secure their supplies at prices which will be satisfactory to them.

Notwithstanding the foregoing, there are some shipowners who apparently still hesitate, and as regards these they should take an opportunity of communicating with those companies who have already successfully catered for the supply of fuel-oil for burning under boilers and who can afford the latest information to the shipowner as to the production of petroleum throughout the world, facilities for the supply of Diesel oil and any other information necessary for the owner to make up his mind and satisfy himself of the security of the supply.

Whilst on this subject it may be of interest to point out that the production of oil in the world has doubled in the last five years, and that new fields with great possibilities have hardly yet begun to produce anything like the quantities that may be expected later on. There has been a lot of talk about the exhaustion of production, but, as is well known, the production in America has been greatly increased, and, after all, of the world's production America supplies the largest part.

With oil there is bound to be a somewhat different situation than with coal. With coal it is possible to block out the quantity and ascertain with reasonable accuracy the available supplies. With oil this is largely a question of the drill. Then, again, whereas oil has to be stored and carried in special facilities, coal can be stored on any vacant land and transported by ordinary cargo boats. In spite of this, we believe that those shipowners who have been and are utilizing fuel-oil for burning under boilers, have found the arrangements made for supplying fuel-oil adequate and in every way satisfactory, and that they have been able to secure all the supplies that they required. Oil is now obtainable all over the world where ships are likely to require it.

Another factor which the owner who decides on Diesel engines has in his favor is that he is a more economical consumer of fuel-oil than the owner who burns fuel-oil under boilers; the consequence is that he not only uses less, but from the supply point of view the larger the number of Diesel-driven boats available, the further, whatever the oil supplies may be, will they go.

Whilst on the subject of supplies, it should be pointed out that the Diesel engine has undoubtedly by no means reached finality in its improvements, and those makers whose engines are not already capable of utilizing what are known as the heavier fuel-oils which are today burned under boilers, are endeavoring to adjust their engines so as to burn these heavier oils. This is, of course, a very important factor both from the point of view of supplies and price.

Until recently, except in the Orient, practically nothing but what is known as gas-oil was used in Diesel engines, but for many years in the Orient we have supplied a fuel-oil for Diesel engine users which has given them every satisfaction and is today used not only by Diesel engines, but smaller internal-combustion oil engines.

As regards the question of price, from what has been said above regarding the production, transport and storage of oil, it will be clearly understood that there are bound to be fluctuations. If a period of years is taken, it will be found that the increase in the demand for any petroleum product, if normal, has usually had very little effect on the price, but at times there are abnormal demands, and as a rule the first tendency of such an abnormal demand is to create a situation where the stocks are drawn upon. In this event, the prices of crude rise, with a resultant increase in the cost of the products. The second result is, as a rule, an over-production, with a resultant fall in the price of crude, which ultimately affects the price of the products again.

These fluctuations are bound to occur, but there is no reason to anticipate that these fluctuations would be of such a nature as to render prices prohibitive. After all, the object of all producers must be and is to endeavor to supply the needs of their customers as economically as they can possibly do. And, the supply of fuel-oil under boilers, regardless of the enormous increase in the demand during the last few years, has been met without prices reaching a level

(*Continued on page* 26)

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(*Continued from page* 24)

which prevents the well-known economies of burning fuel as compared with coal diverting the shipowner to coal, in spite of the fact that the prices of the crude-oil has forced the suppliers of fuel to increase their prices. Most shipowners who have been using oil under boilers are more and more working on the basis of taking their supplies over a period and fixing contracts to cover this period. This should limit the fluctuations in price, besides enabling the shipowner to be satisfied about the price and supply. As already stated, the Diesel-engined vessel, using smaller quantities of oil, will, as they increase and fuel burners are withdrawn, automatically increase the supply of oil available if they are able to utilize the present bunkering fuels. As is generally known, we ourselves have just placed orders for six large Diesel-engined boats, augmenting many other motorships that we own, and the proportion of new boats building all over the world, which will be engined with Diesels, represents a very large part of the new tonnage building.

It may be of interest to give the following statistics, which have been issued by Lloyd's Register, showing the increase in tonnage of oil-fired steamers (new and converted from coal burner's) and new motorships between the years 1914 and 1924:

Year	*Oil-fired steamers* Gross Tons	*Motorships* Gross Tons
1914	1,310,209	234,287
1919	5,336,678	752,606
1920	9,359,334	955,810
1921	12,796,635	1,248,800
1922	14,464,162	1,542,160
1923	15,792,418	1,608,414
1924	17,154,072	1,975,798

From the above figures, the logical conclusion is that the continual increase in Diesel engine tonnage can be directly attributed to the undoubted economy of this class of tonnage not only in fuel-oil consumption, but also in the many advantages such reduced fuel consumption brings.

The companies occupied in the sale of petroleum are naturally following the progress of the Diesel engine very closely, and it is perhaps not sufficiently realized that we ourselves hold stocks of Diesel fuel available at a great number of places in our world-wide chain of bunkering stations. We can supply Diesel oil today at:

Adelaide, Avonmouth, Barton (Manchester Ship Canal), Canton, Colombo, Gothenburg, Hull, Karachi, Liverpool, Malmo, Melbourne, Nagasaki, Palermo, Perim, Portland (Ore.), Pulo Bukom, Rio De Janeiro, San Francisco, Singapore, Suez, Tarakan, Venice.

Amsterdam, Balik Pappan, Batavia, Boelebaai Ceram, Cape Town, Copenhagen, Hamburg, Ichang, Kobe, London (Shell Haven & Thames Haven), Naples, Pangkalan Berandan, Pernambuco, Port Sudan, Puloe Samboe, Sabang, San Pedro, Soerabaya, Sydney, Trinidad, Yokohama.

Antwerp, Bangkok, Bergen, Bombay, Cebu, Curacao, Hankow, Jarrow on Tyne, Leghorn, Macassar, Manlia, Miri, New Orleans, Piraeus, Puerto Mexico, Rotterdam, Saigon, Shanghai, Southampton, Svolvaer, Tuxpan.

Aomori, Barcelona, Bilbao, Calcutta, Christiania (Soon), Genoa, Hong Kong, Lisbon, Madras, Marseilles, Mombasa, Palembang, Penang, Portishead, Rouen, Saitozaki, Seattle (Washington), Stockholm, Tampico, Vado.

We are adding Diesel oil at those places where the trade requires it, with a view to giving the same service which we find has been so much appreciated by shipowners who have used our oil under boilers. In this connection, we might mention that one of the great advantages which the Diesel-engined boat has over the oil and, more especially, the coal burner, is that she is to a much larger extent able to select her bunkering points and can bunker for the whole voyage in many cases, if she happens to be loading or discharging at a cheap oil port. She is not bound to pick up bunkers all along her route, as is especially the case with coal boats, so that when freights are low the Diesel-engined boat can pick up her supplies at the cheapest point.

It is to the interest of the suppliers to do everything they can to give satisfaction to the owner of motorships, and this is the object which is continuously before us, and we trust that we shall be able to give the same service as we have been able to give in regard to boiler fuel.

There is one general point that perhaps might illustrate the situation in regard to Diesel oil, and that is that there was a time when the same kind of doubts which appear to exist in some people's minds were expressed in regard to the supply of petroleum for the automobile. It was thought that the supplies would be insufficient and the price prohibitive. Facts have proved the contrary, and it is due to the foresight of the suppliers of petroleum that, in spite of the enormous increase in the use of the motor-car and the motor-truck, supplies have been always available and prices have never been prohibitive. Actually, owing to the over-estimation of the demand, there has been in the current year a very heavy over-production. This illustration, to our mind, sums up exactly what we have stated above, and shows that the oil trade is similar to any other trade in that it is liable to the same laws of supply and demand.

The world's production of crude petroleum has never been bigger than at present, as will be seen in the comparative statement which follows, and new fields are being developed, so that fears of a shortage of supply or any idea of exceedingly high prices should not prevent owners who are otherwise convinced that the Diesel-driven ship is the vessel to own today, from building boats of this type.

	Barrels of 42 American Gallons
1918	514,729,000
1919	546,558,000
1920	688,474,000
1921	765,099,000
1922	854,809,000
1923	1,010,995,000

Owners' Trials of French Motorship Camranh

Sea trials took place during December of the Chargeurs Reunis new motorship CAMRANH, which has previously been described and illustrated in MOTORSHIP. It will be recalled that she is propelled by twin Sulzer single acting Diesel engines of 1,700 s.h.p. each from six cylinders per shaft, 26.77" bore by 43.30" stroke. The following are particulars of the ship and trials:

Loaded displacement	17,170 tons.
Deadweight capacity	11,700 tons.
Net-cargo capacity	10,850 tons.
Weight of twin main engines	384 tons.
Power of main engines	3,400 s.h.p.
Power of auxiliary Diesel engines	446 s.h.p.

	Port engine.	Starboard engine.
Duration of trials (hours)	8½	8½
Revolutions per minute	85.36	78.25
B.h.p. (mean)	1,710	1,750
B.h.p. absorbed by motors for blowers and pumps	82.1	82.1
Fuel consumption of auxiliaries per b.h.p. hour of main engines	0.022	0.024
Fuel consumption per b.h.p. hour (main engines) (lb.)	0.385	0.375
Total fuel consumption per b.h.p. hour (lb.)	0.407	0.399
Scavenging air (mean) pressure (lb. sq. in.)	1.5	1.5
Cooling water pressure (jackets)	7	7
Cooling water pressure (pistons)	30	30
Low pressure stage of air compressor (lb. sq. in.)	20	20
Intermediate pressure stage of air compressor (lb. sq. in.)	135	130
High pressure stage of air compressor (lb. sq. in.)	925	900
Cooling water temperature at inlet (deg. Fahr.)	46	46
Cooling water temperature at cylinder outlet	100	100
Cooling water temperature at piston outlet	122	115
Temperature of exhaust	450	470

The lubricating consumption for both engines was 4 gallons during an 8-hour period. The auxiliary Diesel engines comprise two Sulzer units of 410 b.h.p., one surface-ignition oil-engine of 30 b.h.p. and another surface-ignition oil-engine of 6 b.h.p. In addition to furnishing electric power for the ship's auxiliaries current is also provided for two 200 b.h.p. electric motors each driving a turbo blower at 250 r.p.m. for scavenging the main cylinders. The CAMRANH is to be placed in the Far Eastern service of her owners.

For their Deli-Straits China Line two 4,650 tons net combination passenger-cargo motor-liners have just been ordered by the Netherlands Steam Packet Co. from the Netherlands Shipbuilding Co. and the De Schelde Shipbuilding Co., respectively. Their names are to be TEN NOORD and VAN HEUTZ. In the first named a six-cylinder 28.76" by 51.18" Werkspoor four-cycle Diesel of 2,000 s.h.p. will be fitted, while the other boat will have a Schelde-Sulzer two-cycle Diesel engine. Dimensions of ships, 390' by 52' by 27' 6"; registered tonnage, 4,650.

A second edition has been issued of the book entitled "Propelling A Cargo Boat" reprinted from the Story of Shipping published by Sports & Sportsmen, Ltd. This contribution, the subject of Diesel-engine propulsion, is by D. B. Morison, Managing Director of Richardsons-Westgarth, Ltd.

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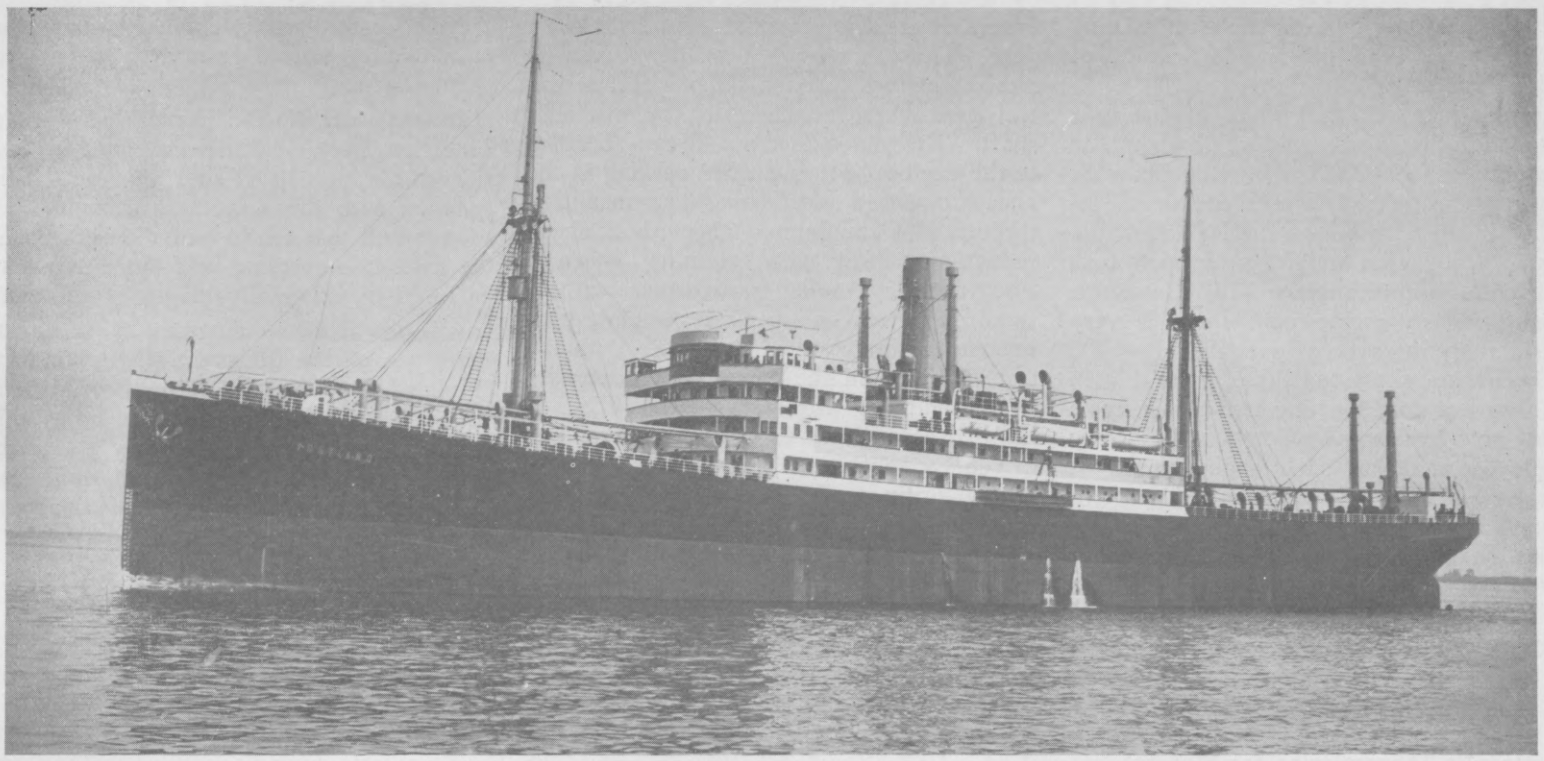

M. S. "Vogtland." The Hamburg-America Line's new combination passenger and cargo motorship. Twin 1,650 s.h.p. M.A.N. Diesel engines drive her propeller through single reduction gears

Reduction Gearing and Double-Acting Engines

Strong Endorsement of these Systems Given by Important German Engineers

"Geared transmission is the most important development in shipping propulsion which has been made during the last 15 years," declared Dr. H. Frahm of Blohm & Voss, Hamburg, well-known German ship and Diesel engine builders, in a paper recently read before the German Institution of Naval Architects.

After dealing with the development of gears in conjunction with the geared turbine and the past efforts for the utilization of gears in conjunction with high-speed submarine type Diesel engines for mercantile work, Dr. Frahm referred to the specially designed high-powered Diesel installation in the Hamburg South America Line's 14,000 tons gross motorship MONTE SARMIENTO which left Hamburg on her maiden voyage last November. In this ship twin screws are driven at a normal speed of 76 r.p.m. by four 6-cylinder, 4-cycle single-acting Diesel engines running at 215 r.p.m. and developing together a total of 7,000 s.h.p. From tests which were made it was decided that elastic hollow shaft couplings were unnecessary and they were accordingly dispensed with. In the case of the merchant ships fitted with submarine engines and reduction gears, namely the HAVELLAND and MUNSTERLAND of the Hamburg America Line, direct gearing was particularly attractive by reason of its high efficiency of nearly 99 per cent, which stood out against a much lower overall efficiency given by electric and hydraulic transmission.

In order to take up the inertia at the moment of reversal, particularly during maneuvering, automatic air brakes have been fitted to the engine flywheels. For the purpose of securing the necessary elasticity between the engine flywheel and the gearing, hollow pinions were fitted, these being driven by an internal shaft passing through the pinion and bolted to a coupling at the outer end of the pinion shaft. So constant was the turning moment obtained that the

M. S. "Vogtland." Left—cozy corner of the lounge. Note the beautifully-matched panelling. Right—first-class dining saloon

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German Lloyd agreed to the shafts being made according to the standard rules of turbine shafting.

Installations of 2,000 s.h.p. of the type installed in these ships only weigh about 218 tons and cost 290,000 marks, whereas a direct-drive crosshead Diesel engine as installed in the Hamburg America's new motorship VOGTLAND weighs about 438 tons and costs approximately 418,000 marks. The saving in engine-room space is very considerably in favor of gear drive.

Dr. Frahm expressed the opinion that in the future a double-acting two-cycle engine of the port-scavenging type would be widely employed and that such engine could be directly coupled to the propellers or that two engines would be coupled to a single propeller shaft by means of gearing. This opinion was supported by Director Goos, who also stated that the method of power transmission must, in every case, be selected to suit the particular case of individual vessels.

Hydraulic Transmission for Motorships

Discussing the use of hydraulic transmission in conjunction with reduction gear drive for Diesel engined motorships, Dr. G. Bauer, Director of the Vulcan Werke of Hamburg, stated that the use of this mechanism in the cargo-ship VULCAN had proved very successful in four operations between the North Sea ports and the Mediterranean. All sailings have been completed according to schedule and there has been no stoppage for repairs to the machinery of any nature.

It will be recalled that this vessel was described and illustrated in MOTORSHIP last year. There is a single propeller driven by two oil-engines through pinions and a central gear-wheel attached to the propeller shaft. The pinions are not directly coupled to the engine shaft, but when turning in the ahead direction the drive is transmitted through a hydraulic coupling without speed reduction, whilst when running astern a Foettinger hydraulic transformer with a small reduction in speed is employed to reverse the direction of rotation. Both the transformer and the coupling are operated by oil and the wheel spaces are filled or emptied as required by transformer pumps driven by bevel gears on the pinion shaft. Maneuvering is accomplished by controlling the supply of oil delivered to the transformer and coupling wheels.

Careful record was made of data during the voyages. For instance, on one trip the machinery developed 580 h.p. at the shaft with the oil engine turning at 307 r.p.m., the shaft speed being 87½ r.p.m. The ratio of this speed reduction is 3.51 to 1, the slip in the head coupling being 2½ per cent. The maximum stern power was 470 shaft h.p.

Orders have been placed for several additional vessels to have Diesel engines and hydraulic transmission. These include the 9,500 tons d.w. motorship for the German-Australian Line and a cargo motorship of 3,800 s.h.p. for the Hansa Line; two 9,500 tons vessels of 3,000 s.h.p. for the Hugo Stinnes Line, and a 490 s.h.p. tug. These ships are building at the Vulcan Shipyard.

Dr. Bauer referred to designs which have been gotten up of a motor-passenger liner of 40,000 s.h.p. to be equipped with eight 2 cycle double-acting engines coupled in pairs to four Vulcan gears driving two propeller shafts.

In support of Dr. Bauer's discussion Chief-Engineer Gerhards said that he considered the high-speed Diesel engine in conjunction with this drive was a commercial success and that the loss of 2½ per cent in the hydraulic coupling was more than outbalanced by other advantages of the gear.

A series of torque diagrams taken during the trials of the MONTE SARMIENTO were exhibited by Chief-Engineer Berendt and these showed that in the case of a solid shaft arrangement vibration only took place at low speeds and then only to a very small degree, indicating that a special elastic coupling was not necessary.

Tug with Diesel Reduction Gear Drive

A new oil-engined tug to be named the JOHN CONNELLY is to be built by the Globe Shipyard, Inc., Buffalo, which vessel is to be a duplicate, with machinery modifications, of the oil-engined tug MATTICH described and illustrated in the December issue of MOTORSHIP and which is in service on the New York State Canal. The JOHN CONNELLY, however, will be propelled by one of the new Fairbanks, Morse Diesel engines of 200 s.h.p. driving the propeller through Falk-herringbone reduction gears.

For the time being the plan to build a cargo-carrying motorship for the New York State Canal has been abandoned by the Globe Shipyard. At a later date it is possible that three such ships may be laid down.

Current Book Reviews

The Ship and Her Work

The whys and wherefores of the modern ship are presented in an understandable and original way by a recently published little volume entitled "The Ship and Her Work." Written primarily for laymen, it nevertheless treats the subject in a way that would have been impossible had the author been less broadly and accurately informed than is actually the case.

"The Ship and Her Work" is an extraordinary example of what can be done by a full-fledged technician in the way of "getting across" to his readers the fundamentals of his subject. Almost every branch of scientific or technical knowledge is difficult of presentation, because of the fact that the reader or pupil must be drilled in fundamentals before it is possible to build up in his mind a structure of facts essential to real comprehension.

Sir Westcott Abell, K.B.E.—chief surveyor of Lloyds—has adopted a delightful conversational method for imparting to his readers a certain amount of that habitual familiarity with fundamentals which is to form the background and the basis of the information which constitutes the meat of the book. What is after all a primer-like repetition of simple lessons is so skilfully clothed with anecdote and a pleasing turn of phrase that not even the ship technician is at first aware of what is going on. For that reason, needless to say, even the man who knows all about ships can derive substantial benefit from this little volume.

"Sea Engines," the concluding chapter of the book, gives a useful summary of the various types of power plant used at sea to-day. Briefly but interestingly sketching the history of the marine steam engine, he tells of its partial replacement by the direct-drive and geared turbine. As would have been expected from an author whose general treatment of the subject shows so high a degree of ability, he has taken the trouble to acquaint himself with the fundamental aspects of Diesel marine propulsions and leads up to the climax of the chapter and the book with—"There is little doubt that the era of the oil-driven ship has more than dawned, and another phase of the mastery of the seas has been entered upon with increasing advantage to the welfare of the community." Published by Gee & Co., London.

German Oil-Engine Book

Concentrating on the development of heavy-oil engines of the slow-speed type after the close of the World War, German manufacturers have made all possible efforts to regain the lead which they had lost. As the result of these intensive commercial efforts, a considerable amount of scientific material has been made available and has been published from time to time in the trade and technical press.

Summing up the best of what has been done, Dr. Wilhelm Scholz has just published the third and enlarged edition of his already well-known work, "Marine Oil Engines (Schiffs-Oelmaschinen), published by Julius Springer and obtainable from Motorship Technical Book Department.

Whereas a good deal of the material recently published on German oil engine developments was concerned largely with a description of the high-speed U-boat engines, Scholz's book covers the crosshead-type of cargo-ship engine very completely. It is by far the most practical German book which has so far come to hand and is free from all but the most rudimentary scientific impedimenta.

Framing, cylinders, reciprocating parts, and valves are studied from a thoroughly mechanical point of view with the help of actual working drawings. An unusually high degree of drafting skill is manifest in these illustrations and their reproduction on good-quality paper is excellent. A number of engines are being built in Germany under foreign license from firms who have hitherto permitted the publication of little or no engineering material. The licensees have apparently not been subject to these restrictions and have given Dr. Scholz access to drawings which would probably never have been released in any other way.

Practical operating considerations form an important part of the consideration given to every engine part, and at the end of the book an extended section is devoted entirely to operating questions. Airless injection and supercharging are studied with the help of clear illustrations and drawings.

Considerable attention is devoted to the use of reduction gearing in connection with high-speed light-weight oil engines. One of the examples prominently displayed as an illustration of this discussion is the Falk engine and reduction gear drive.

The Petroleum Register

"The Petroleum Register" is a semi-annual directory and statistical record of the world's petroleum industry and contains maps of the principal producing and prospective oil territory of the United States and foreign countries. Included in the lists are producers, refiners, marketers, jobbers, drilling contractors, oil associations.

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Large Oil Engines, Especially the Double-Acting Type

A Paper on This Subject of Growing Importance Read by Dr. Charles Edward Lucke, Professor of Mechanical Engineering, Columbia University, Before the American Society of Mechanical Engineers, New York

PART I

Efforts to build large oil engines have been growing in number and in variety of means selected to meet marine requirements, stimulated by the success of motorships and the desire to increase their size or utility in prevailing sizes. Possible stationary applications of larger oil engines have also contributed additional motives and other solutions. Much of this work has not been published and is therefore not as well known to the engineering profession as it deserves by reason of its high quality and the foundation it lays for the future. This paper is concerned with a review of some of this work, with special reference to double-acting engines.

One of the problems considered is that of the possibility of raising the mean pressure in the cylinder to get high horsepower per cubic foot of displacement and without rise of maximum pressure to thereby reduce the weight per horsepower. High injection-air pressures, extra injection air, and supercharging of cylinders are included here in addition to studies of shape of combustion chamber, position of sprayer, and design of spray valve. A second one is that of determining the maximum diameter of cylinder that can be operated at very high or at moderate mean pressure without injury to the metal of cylinder piston or cylinder head, with particular reference to the effect of special designs of these parts for resisting heat damage at a given heat-generation rate or the corresponding relation of diameter and mean indicated pressure.

A third problem is that of securing results in two-cycle cylinders as nearly as possible equal to those of the earlier developed and more widely standard four-cycle, to determine how close the former can be brought to half the weight per horsepower of the latter on the one hand, and on the other for the same size of cylinder and similar engine structures how close to twice the maximum horsepower of a four-cycle engine it may be possible to build the two-cycle. Still another, from the standpoint of double action of the piston, assuming a given diameter and mean pressure or heat-generation rate established in four- or two-cycle single-acting cylinders, and a construction of cylinder, piston and cylinder head not injured for these values, is that of determining the practicability of making both ends develop the same power in both four-cycle and two-cycle engines. This includes the determination of how close to half the weight per horsepower of the single-acting it may be possible to build the double-acting engine or how close to twice the maximum horsepower of the single-acting it may be possible to make the maximum horsepower of the double-acting. Some of the double-acting designs published are reviewed, including the rodless piston and the double opposed pistons.

Introduction

DEVELOPMENTS in prime movers always have been and always will be matters of major interest to engineers, and any progress in the direction of enlarging the scope of usefulness of the internal-combustion engine with its inherently high thermal efficiency is of special importance. The success of the small units in the form of the high-speed gasoline engines, especially in the field of transportation, has been so remarkable as to have repeatedly raised the question as to the future of the large units in the form of the Diesel oil engines burning fuel oil. This uncertainty about the large engines would of itself justify an engineering survey, but when, in addition, it is known that much work has been done, most of which is as yet unpublished, and that the results of this work indicate new possibilities for large engines, a review of the situation is doubly important.

2. There never has been any doubt about the high thermal efficiencies of Diesel oil engines, and such doubt as once existed as to their reliability or maintenance costs has been completely dissipated by the success of the motorship, as great in its way as that of the automobile on land and of aircraft above. However, even in spite of the proved stability of the motorship engine when properly designed, with due recognition of that body of engineering data which is steadily accumulating through experience and research, there have been, and in some respects there still are, many questions to be answered about the future of the large oil engine. This is but an indication of zones of unexplored possibilities which year by year will be narrowed by increasing knowledge, with definite answers to questions of how progress may be made and in what direction there is no hope of gain.

3. Of the big-engine questions of broader significance, perhaps the two that stand out or are most often heard are: How may the zone of economic use be widened for such Diesel engines as have become more or less standardized as to design or size? and, second, how large, how much larger than these standards in horsepower capacity, may good oil engines be built? The answers to these questions involve all the facts, questions, and experience so far accumulated and in addition some degree of speculation, but every day some speculation may be replaced by facts and accomplishments.

4 Widening of the scope of economic utility of large oil engines in existing sizes whether in marine or in stationary fields of competition with other prime movers is mainly a question of reduction of weight, and through it a reduction of first cost on the assumption of a more or less constant ratio of labor to material in production. Reduction of first cost reduces fixed charges in the cost of power, and this is the biggest single item against oil engines in competition with steam. Reduction of first cost of large oil engines toward the cost of steam plants would result in a wholly different picture of adoption and use than has heretofore prevailed. It is not at all necessary to improve efficiency or fuel consumption, nor is it necessary to reduce maintenance or attendance below existing figures, though, naturally, any gains here will help the oil engine, provided they do not prevent reduction of first cost. Reduction of cost is primarily a matter of weight reduction in pounds per horsepower, except when it is accomplished by the use of special high-priced materials, or when it requires excessively expensive shop operations or higher ratios of labor to material in the building of the engine. It is true, however, that there are some applications where weight reduction would result in new adoptions of oil engines even without cost reductions on other grounds than power costs compared with steam, as, for example, in navy vessels.

5 One set of engineering problems of primary interest in connection with large oil engines is concerned with the means whereby weight reductions may be made with more or less proportionate reductions in cost and without loss of reliability in operation or life of parts. When, as is the case here, more than one possible course of procedure is open, there arises the additional problem of weighing one against the other; the problem of choice.

6 The second broad question, that of maximum possible size, with or without weight reduction but, of course, preferably at lesser weight per horsepower than prevails at present, is perhaps of equal importance but really of greater engineering interest. What applications will be made of oil engines of larger sizes than have prevailed in ships, commercial or naval, and in stationary installations will of course depend on just what may be their characteristics as to weight, cost, and reliability, with efficiency maintained. It is, however, quite certain that such availability must result in some adoptions and changes in engineering practice, and anything in this direction is sure to be important.

7 A second set of engineering problems in connection with large engines is therefore concerned with the determination of maximum possible horsepower per cylinder, and of the means whereby horsepower per cylinder may be made greater without loss of other good qualities, and preferably also with reduction of weight and first cost. As in the problem of reduction of weight per horsepower, so also in this problem of increase of horssepower per cylinder, all of the several possibilities must be weighed and a selection must be made, and in the selection there must necessarily be some elements of opinion and judgement.

PART I

Sizes and Arrangements of Big Engines

8 Among the larger sizes of Diesel engines, those in which the arrangement of parts was first brought to a state of acceptably satisfactory perfection on a considerable scale were of the four-cycle air-injection type, single-acting, some with trunk pistons, but all of the larger, more reliable designs with the crosshead style of main running parts. Efforts to reduce the weight per horsepower of these single-acting four-cycle engines have extended over many years and still continue. Here two quite independent lines of attack are recognized in addition to the perfectly obvious one of increased speed with its limitations of life above recognized values for piston speed. The first of these is consecured with securing higher mean effective cylinder pressures by suitable treatment of air and fuel supply and their proper combination through controlled cylinder combustion. The second is directed toward the metal and its weight in pounds per cubic inch of cylinder, measured by the product of area, stroke, and number. There is obviously no relation between these two lines of attack since maximum pressures may be assumed equal in all Diesel engines, though they do together determine the weight per horsepower of the power plant.

9 Increase of indicated mean pressure is being secured in various ways, among the most notable of which are the following: Higher spray-air pressures to carry fuel to the more remote points of the air charge and by agitation of the whole charge to effect the combustion of more fuel per pound of air than otherwise, reducing free oxygen in the exhaust to the lowest possible value with no carbon monoxide; extra spray air injected at points other than the spray valve to increase turbulence and to produce similar effects; two spray valves instead of one to reduce the distance the fuel must travel to find its air, and to reduce the weight of air for a given piston displacement and so to raise the mean pressure for the same completeness of oxygen utilization by fuel as shown by free oxygen in the

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exhaust, it having been employed with and without the former means of raising mean pressure.

10 By research along such lines it has been found possible to secure indicated mean pressures of 150 lb. per sq. in. without super-charging, and 176 lb. per sq. in. with supercharging. With such high values established as attainable it is a fact that the mean pressures in actual use for engines at regular work are very much lower, especially in cylinders of considerable size. The values for these commercial engines seem to have been establishd by Burmeister & Wain's experience in their motorship engines, the first to secure a position of real success on a considerable scale at sea, and these values for mean indicated pressures are 100 lb. per sq. in. for stationary, and 88 lb. per sq. in. for marine engines under constant full load in cylinders of 30 in. diameter, more or less. Some of these four-cycle engines have been rated a little higher than this but many are found with lower values, and it is fair to say that the usual values for indicated mean pressures are 60 per cent—more or less—of those proved by research to be obtainable.

11 Not very much has been accomplished in the direction of decrease of metal weights of the engine structure for a given cylinder size for these four-cycle single-acting engines, nor does it seem possible to go very far here without increase of cost per pound as much as or more than pounds per cubic inch may be reduced. Expereince has proved the necessity for the closed box type of frame in the interest of pump lubrication and of maximum frame stiffness for maintenance of bearing alignment, and with steel tie rods to main bearing to take direct tension loads of gas pressures acting on cylinder heads. Such an engine structure designed with maximum allowances for safety and reliability for such large four-cycle, crosshead, six-cylinder, long-stroke marine engines of about 30 in. bore, will weigh about 4.20 lb. per cu. of stroke volume. This may be regarded as a maximum. Neglecting other frame arrangements, especially open classes, as not suitable, the minimum for the enclosed box type of frame may be taken as the value for the German trunk-piston submarine engine of the late war, where special material was used and pound costs further raised by much increase in labor of construction. Here the largest cylinder bore was 21 in., with stroke equal to bore, or 7273 cu. in. of stroke volume, and the weight was 16,600 lb. per cylinder, or 2.28 lb. per cu. in. There is, therefore, 4.20—2.28=1.92 lb. per cu. in. range between a design so high in pound cost as not to reduce cost per horsepower but increase it—and with trunk piston, and the other design which, while satisfactory from the pound-cost standpoint and safe in service, may yet be reduced somewhat.

12 These difficulties in reduction of weight per horsepower for the most widely used type arrangement, the four-cycle single-acting engine, which increase as horsepower per cylinder becomes larger, have led other investigators to approach the problem from different angles. The first of these is the substitution of the two-cycle arrangement for the four-cycle. Here there is nothing to be saved in pounds per cubic inch of stroke volume—rather an increase may be expected, because the scavenging pump and its connections will weigh more than the four-cycle valve gear that it displaces. Nor is there any prospect of using higher mean pressures—quite the contrary, because even with the identical air and fuel conditions the mean indicated pressure for the effective part of the stroke will be equal to that of the four-cycle cylinder, and for the whole stroke something less by an amount dependent on the length of the exhaust port, which measures the ineffective part of the stroke. Such exhaust ports are 20 per cent of the whole stroke, more or less, so that the effective stroke is 80 per cent ± of the whole, and the indicated mean pressures 80 per cent ± of the values for four-cycle cylinder, provided combustion conditions are equal.

13 On the other hand, however, doubling the number of working strokes for speeds equal to the four-cycle results in the two-cycle engine, otherwise similar, approaching toward 75 per cent the weight per horsepower. How close this approach may be depends on the length of the exhaust port, the relation between the indicated mean pressures for the effective stroke of the two-cycle and the full stroke of the four-cycle, and the amount of excess weight per cubic inch of the scavenging pump of the former over the valve gear of the latter. There is, of course, a higher rate of heat generation per square foot of cylinder approaching twice the value of the four-cycle for equal bores, which would seem at first glance to limit the two-cycle to smaller cylinders and perhaps in the attainment of lower weight per horsepower would result in a lower maximum horsepower per cylinder, so that both ideals would not be attainable. At one period these matters were much more speculative than they are now, and they have been the basis of some rather extended debates, not always kept within the bounds of professional discussion; but experience has been accumulating rapidly through a great variety of two-cycle research investigations and engineering developments by practically all of the engine-building nations.

14 It has been definitely established that combustion conditions can be secured in two-cycle cylinders which are quite as good as in four-cycle, so that attainable indicated mean pressures for the former for the effective part of the stroke may be accepted as equal to values for the latter, full stroke. It has also been proved that air charging of the two-cycle cylinders by ports with no head valves whatever, can give air charges necessary for such equalization of mean indicated pressures[1] if the scavenging is properly done. Therefore heads may be so simplified, compared with multiported four-cycle heads, as to be able to withstand uninjured the higher heat rates typical of the two-cycle engine of the bore equal to the four-cycle. This is a most important accomplishment because it contributes directly to the attainment of both ideals at once; the reduction of weight per horsepower and larger horsepower per cylinder, but whether the amount of these gains is sufficient is yet to be seen, as is also the question of still other means of approach.

For such single-acting two-cycle engines, indicated mean pressures for the full stroke have reached the value of 122 lb. per sq. in. with an effective stroke of 77 per cent, making equivalent mean pressure 158 lb., which checks well against the four-cycle maximum values. As in the case of the four-cycle, however, the rating values are lower, Sulzer using the value of 93 lb. per sq. in. equivalent for same port lengths to 120 lb. per sq. in. for cylinders of about the same bore—between 20 and 30 in. These ratings correspond to substantially twice the heat-generation rate per square foot of the four-cycle engine, and are indicative of the ability of the simpler structure of the two-cycle cylinder, especially the head, to stand higher heating rates than four-cycle forms.

[1]The Diesel Engine of Today, by A. Naegel, *Zeit. Ver. Deut. Ing.*, June, 1923.

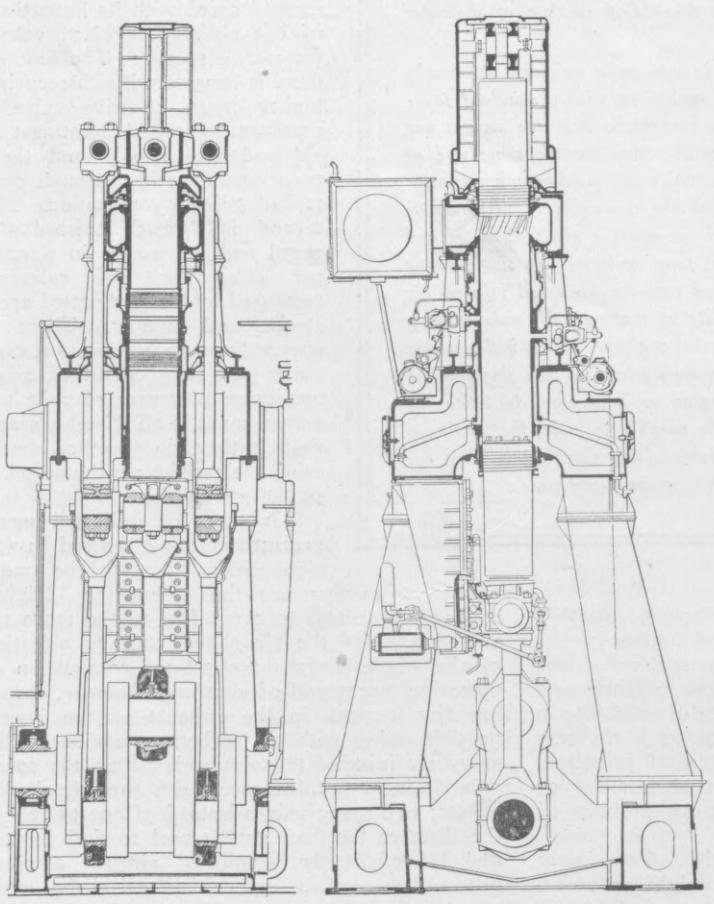

Fig. 1. Side elevation and end elevation of Doxford-Junkers opposed-piston two-cycle engine

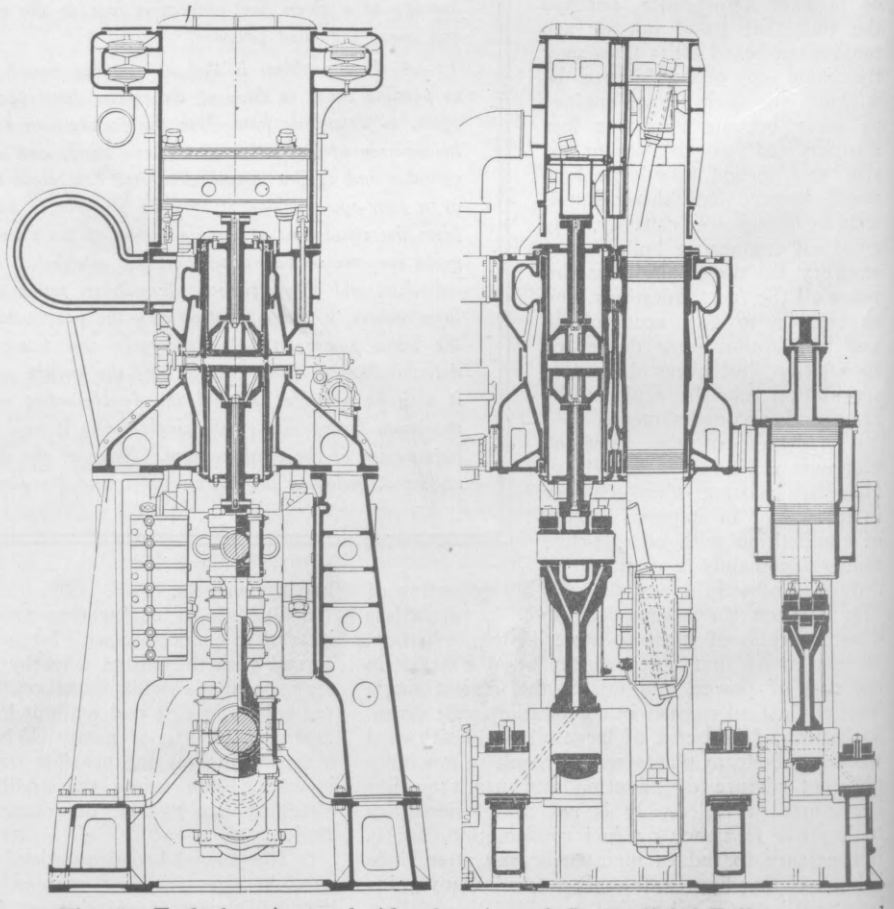

Fig. 2. End elevation and side elevation of Cammellaird-Fullgar opposed-piston two-cycle engine

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with more complicated parts when made in similar ways of casting. It seems, therefore, that there is a real gain in horsepower per cylinder for two-cycle cylinders of the same bore compared with four-cycle, but which, as in the case of four-cycle, is less than the maximum attainable by combustion—about 50 per cent, more or less. Indirectly this points to the practicability of higher heat generation rates per square foot in two-cycle cylinders of equal thickness and diameter, and to the probability of more favorable metal conditions for high over low periodicity of heat charges with equal hourly rates. While there is some increase in weight per cubic inch (about 0.5 lb.), there is a substantial reduction made in weight per horsepower by doublign the impulses.

Finally, there is to be noted in this series of efforts to reduce weight still another and the most recent; doubling the number of impulses by the double-acting method, with its parallel of double opposed-pistons. A double-acting piston should give nearly twice the output with piston-rod allowance obtainable from the single-acting, either wo-cycle or four-cycle, with not much increase in weight over the standard single-acting crosshead designs, provided combustion conditions are equal and permit of equal indicated mean pressures. This mode of decreasing weight per horsepower does not at all increase the heat generation rate over the single-acting because each end acts independently. Therefore it not only contributes something to the first ideal of cost reduction through weight, but, unlike other directions of effort, it contributes quite as much to increasing the horsepower per cylinder and the maximum practicable horsepower of the engine. So obvious does this seem that it excites some wonder at the deficiency of commercial, or even naval, double-acting engines in service, either two or four-cycle. An examination of this question indicates a very interesting situation but one not at all unnatural, considering the pioneer nature of the project and the great cost of all experimental development typical of big-oil-engine work.

The first to be noted are the opposed-piston engines of Junkers and Fullagar, which are arrangements for doubling the output of a cylinder of given bore by a single-acting working piston at each end, and differ from each other mainly in the running gear connecting the two pistons to the crankshaft as in Fig. 1, the Cammellaird-Fullagar, and Fig. 2, the Doxford Junkers. Both involve directly or indirectly the structural ideas that cylinder heads and piston rods are unsafe elements in an oil-engine, and they are accordingly eliminated. They also involve the fnctional idea that when the air enters one end of the cylinder driving hot products out at the opposite end, scavenging is better than when otherwise arranged. The mechanism arrangements as to effects on frame loads, turning effort, bearing pressures and other similar matters are also features of some interest, but are secondary to the opposed-piston plan of doubling the output of the cylinder.

(*To be continued*)

New Two-Cycle Double-Acting Engine

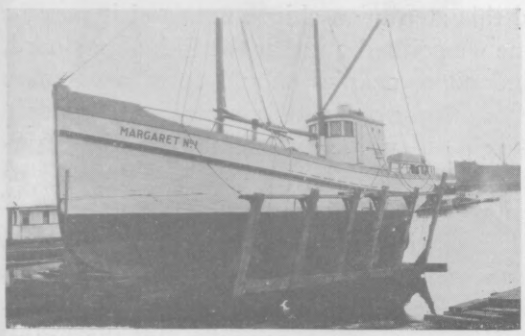
Werkspoor Works, of Amsterdam, Holland, are experimenting with a two-cycle double-acting, port-scavenging Diesel engine developing 1,000 b.h.p. per crank. Werkspoor have hitherto advocated the four-cycle principle exclusively, and recently produced a four-cycle double-acting Diesel in co-operation with one of their licensees. Evidently this company intends to keep apace with all developments in the motorship industry.

Notice to Editorial Contributors

All manuscripts submitted to this magazine for editorial purposes should be typed double space, with three spaces between paragraphs. If possible, there should be two paragraphs to a page of typewritten material. Mss. should be typed on one side of the paper only. All photographs should state on the back what they represent, and should be plainly marked in one corner with the contributor's name and address. The Editor of MOTORSHIP is always glad to receive articles of general interest.

Oil Engined Halibut Fisherman

The oil-engined halibut fishing boat recently built for Capt. Geo. Fritz of Prince Rupert, B. C., by Ericksen Brothers at North Vancouver, and named MARGARET No. 1, is 60 ft. o.a. by 16 ft. beam and equipped with an 80 b.h.p. two-cylinder, two-cycle Skandia surface-ignition oil-engine. This powerful type of boat is now required as the halibut fishermen working out of Prince Rupert have to go far to the westward, often five hundred miles or more in summer, to the best fishing grounds. Capt. Fritz plans to fish during the summer months on Portlock Bank between Cape St. Elias and Kodiak Island, and in winter time somewhat closer to Prince Rupert.



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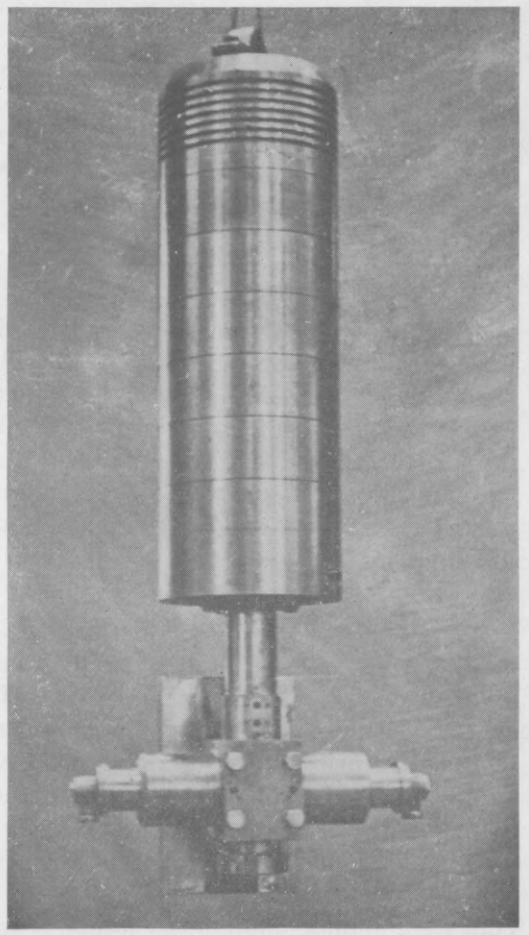
Centrifugal Fuel-Oil Purification

Attention is called to certain important matters connected with the use of centrifugal purifiers for treating fuel oil used on motorships. One of these is the fact that water, which always finds its way into the bunkers, does not generally distribute itself uniformly throughout the body of the oil, but has a tendency to be sucked up in occasional rather than large batches. If the engine does not actually missfire, the quality of combustion is at least considerably impaired, and the partially-consumed oil and water products entering the cylinder foul the lubrication, "stick-up" the rings, reduce compression, and increase wear.

Centrifugal purification reduces the water content of fuel oils to such an extent that only laboratory methods will reveal the slight trace of it which remains. As far as ordinary engineering methods of operation are concerned, centrifugally purified oil is devoid of any trace of water.

Other inorganic non-combustible impurities contained in fuel oils are eliminated for all practical purposes by running them through centrifugal purifiers. Chemical analysis shows that those which remain in the oil after purification are in the combined state, and do not appear as solids until after they have passed through the engine sprayers. Even then they are precipitated in the course of the combustion process as impalpable powders so finely divided as not to cause serious abrasion. Owing to their finely divided state, they practically float on the gases and are carried out of the cylinders by the exhaust currents.



Piston and crosshead of Nobel engine referred to on page 37 of this issue. Note openings in rod for piston-cooling connection.

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From Oil to Coal

THAT many steamships would revert to burning coal immediately this dry fuel became substantially cheaper, simultaneously with a rise in the cost of oil, was a foregone conclusion and is generally recognized. It was confirmed in our pages recently by one of the great oil companies.

It has, however, erroneously been put forward by some authorities as a reason for not building motorships. In announcing a change of six steamers from oil to coal Moore & McCormack figure on a saving of $75 per day per boat with coal and oil at about $5 and $12.60 per ton respectively on the East Coast. "With coal at its current price we can," said A. V. Moore, president of the company, "use oil economically under our boilers up to $9.80 per ton."

The conditions with motorships are not so easily effected, owing to Diesel power burning but one-third of the oil used by an oil-fired steamer. If the first costs, capacities, voyage lengths, speeds and crews of the two types of vessels were equal motorship owners could afford to pay $29.40 per ton for fuel-oil. But, the motorship carries 10 per cent more cargo, on an ocean voyage of average length, has a smaller crew, and has slightly higher speed for the same power. This is largely offset by a higher first cost of about 15 per cent to 20 per cent per deadweight ton (not per net-cargo ton), so the Diesel shipowner cannot afford to pay nearly $30 per ton for fuel-oil with coal at $5, although he obviously can afford to pay considerably higher than the figure quoted for steamers by Mr. Moore. Should the ratio between coal and oil ever increase to an abnormal extent the motorship can always use oil extracted from coal more economically than the steamship can burn the coal itself. Only, in the one case, valuable by-products are left, whereas, in the other, the coal and all its valuable contents are dispersed in smoke.

Problem of the First Cost

FIRST cost to-day is paramount. On the question of dollars and cents hinges the whole matter of steamers and motorships. If Diesel engines and steam machinery were obtainable at the same prices virtually no steamers would be built to-day. In comparing the construction costs of the two types of vessels the most satisfactory and accurate method is to take the net-cargo capacity under deck—not the deadweight—of the one ship and compare it with the capacity of the other ship, assuming both have similar dimensions, power and lines. In some cases it will be found that additional advantages can be secured by making the motorship twin-screw and with higher speed engines, this depending upon the service. Comparison of the net-cargo capacities per ton first cost of the complete ship, will show that there is very little difference in the prices, even if the Diesel engine cost 30 per cent more than a steam plant.

Ship Conversions and Fuel-Cost Savings

APPROXIMATELY 20 per cent of the total operating expenses of a fleet of steam-driven vessels is absorbed by the fuel-oil bill. The Shipping Board's fuel-oil bill alone for the year 1923, aside from a small coal bill, reached $30,000,000," recently stated Meyer Lissner, Commissioner of the United States Shipping Board, in an address before the Seattle Chamber of Commerce. This would indicate that if all the active vessels of the Board's fleet, including passenger liners, were converted to Diesel drive, the annual saving in fuel alone would be about $25,000,000, allowing for a better grade of oil being used by the resultant motorships. Converting the entire active fleet obviously would not be practical as the cost would be not less than $300,000,000. But had a little foresight been shown when these vessels were laid down, one-third of the craft in service to-day would have been oil-engine powered, and the saving in fuel would be about $8,000,000 annually.

This huge saving, however, would not be the only economy because the fuel saving only reaches its maximum in dollars on long distance routes, and there are always many other operating benefits to be derived, the latter increasing in importance on the shorter voyages. It is no wonder that Mr. Lissner stated that: "next to a liberal sales policy, the Construction Loan Fund, which provides money for Dieselizing ships, offers the greatest promise of giving us an American Merchant Marine."

Is There a Dearth of Motorship Engineers?

OCCASIONALLY we hear of shipowners offering as one reason for not investing their money in Diesel power, the statement that there is a scarcity of capable and experienced motorship engineers in this country. Our impression is that this is hardly the case, as not only are experienced marine Diesel operating engineers calling constantly at our office or communicating with us by mail, asking if we know of any suitable position for them, but many of these men are taking shore jobs, including at power-plants, because of their apparent inability to find any attractive openings at sea.

We have made a register of these men's names and addresses, together in many instances with a brief résumé of their experiences, which list has been in preparation for some time. Shipowners who need motorship engineers will be gladly supplied with a copy of this list upon application to this magazine. We cannot, of course, guarantee the men, but must let their own records be the guide to shipowners.

New motorships are constantly being placed in service and more men will be needed, which should be a reason for shipowners to take steps to prepare the way for the future by training good engineers in the art of Diesel engine operation. For many years MOTORSHIP has urged this step upon shipowners and it may be recalled that at one time we pointed out that the Shipping Board, leading shipowners and oil companies should form a common fund for the purpose of fitting out a twin-screw training ship equipped with a two-cycle oil-engine on one shaft and a four-cycle unit on the other shaft, and that such a vessel could be made to pay her own way. Training ships for Diesel engineers have been placed in service by several foreign shipowners. In fact, a steamer has just been converted in Holland for this purpose, as was related in our December issue.

At a meeting of the fuel conservation committee of the Emergency Fleet Corporation recently held at 45 Broadway, a reso-

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lution was adopted looking to the giving of preference to engineers on the honor roll of the Fleet Corporation when selections are made for the crews of the new Diesel-driven ships which the Board is to convert from steam power. The resolution follows:

"That in order that there may be a real incentive for engineers in the existing fleet of the Shipping Board to bring their vessels up to the maximum efficiency and in this way have their names entered upon the semi-annual honor roll issued by the Fuel Conservation Committee, a preference should be given to the applications of those chief engineers whose names appear upon these honor rolls when the time arrives for recruiting and training an engineer force for the ships which are to be converted to Diesel drive. "That for other engineer positions on these motorships below the rating of chief, preference will be given to those engineers of the existing Shipping Board fleet who have demonstrated by their efficiency on ships the chief engineer of which has appeared on honor roll, their fitness for handling an engineer's position on one of the Diesel driven ships."

A large contingent of Shipping Board engineers are attending J. Kuttner's Diesel engine course at the Brooklyn Polytechnic Institute.

Diesel-Engined Fireboat

Oil Engine Power Again Demonstrated for This Class of Service

As yet the heavy-oil engine has not been adopted for fire-boats in this country, but the first American vessel of this type has recently been designed for the Port Commission of Houston, Texas, by Cox & Stevens. This vessel will be about 125′ long by 27′ breadth and 18½′ draft. Her propelling machinery will be of the Diesel-electric class, but the boat will be twin-screw in order to facilitate maneuvering.

Under the conditions which govern the operation of fireboats, the oil engine has advantages unapproached by those of any other prime mover. This has been fully demonstrated by the commissioning of the fireboat BRUHNS in the harbor of Konigsberg on the Baltic Sea.

Although a number of oil-engined workboats and tugs have been equipped with centrifugal pumps for various purposes including the supply of fire-fighting monitor nozzles on the pilot houses, the BRUHNS constitutes the first thoroughgoing object-lesson in the use of Diesel oil engines primarily for fire protection service, although there has been a big surface-ignition engined fireboat on the river Thames, London, for many years.

It is almost superfluous to remind the reader that steam-driven fireboats consume more fuel while standing by than while answering calls and fighting fires. There are perhaps few other cases in which steam engines could be replaced by oil engines with so great a saving as those in which stand-by service requires the uninterrupted and absolutely complete waste of fuel, such as that which characterizes steam fireboat operation.

The oil-engined fireboat with which the Konigsberg fire department has replaced the old coal eater that threatened financial ruin has the following dimensions:

Length, over all	58 ft. 1 in.
Breadth on deck	12 " 9 "
Depth to lower edge of keel	6 " 5 "
Draft, maximum, aft	5 " 1 "

Owing to the fact that the harbor of Konigsberg is situated in a northern climate where large amounts of sheet and packed ice are encountered, the hull is stoutly built but has lines that make her capable of attaining speed and maneuvering well. Transverse watertight bulkheads divide the hull into five compartments, the center one of which accommodates the engine, pump, auxiliaries and tanks.

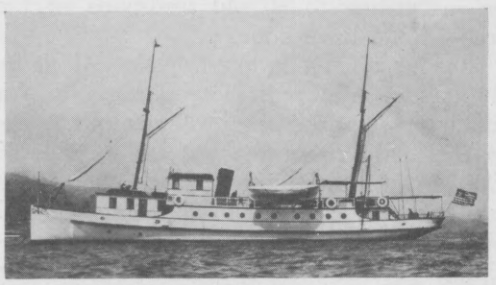
Sixty seconds are all that is necessary to get the engine of this boat under way from stone cold to full power. As compared with the get-away which can be made by a stand-by fired steamboat, this figure is a considerable improvement and shows that the one particular in which a steam job might possibly have been considered superior is in realty favorable to the oil engines.

The kind of engine which is used is a Deutz airless-injection Diesel motor. It develops 100 b.h.p. in six cylinders at 350 r.p.m. and operates on the four-stroke cycle. Fuel is sprayed under high pump pressure directly into the combustion space, which has a shape approaching the spherical. By the use of an enclosed reversing clutch the necessity of making the engine direct reversible has been avoided. The cast steel propeller has a diameter of 4 ft. 3 in.

From the forward or flywheel end of the engine a two-stage centrifugal pump is driven through step-up gearing at 1,350 r.p.m. It throws 1,050 g.p.m. jet against a maximum total head of 230 ft., and requires 88 h.p. to run it. The suction line to the sea-chest has an inside diameter of 6⅞ in., whereas the discharge diameter is 5⅞ in. During extremely cold weather the intake water is tempered by the ingenious method of discharging the cooling water from the engine jackets into the sea-chest.

A severe test was given to this equipment when it was required to run continuously for 138 hours with only two half-hour stops. During the four weeks from June 9 to July 6 every conceivable variety of test was carried out, in the course of which more than 13 hours' running per day were averaged.

Fireboat of the city of Koenigsberg, on the Baltic, has a 100-s.h.p. airless-injection engine and throws a stream of 1,050 g.p.m. against a 230-ft. head



S. Y. "Campanero," completion of her conversion to Diesel power resulted in increased accommodation with reduced fuel consumption

Steam Yacht "Imperial" Being Converted

The well-known Pacific Coast steam yacht CAMPANERO, recently renamed the IMPERIAL by its owner, Willis Walker, a San Francisco capitalist and yachtsman, has been dry-docked at the Crowley Shipbuilding Company for the purpose of converting from steam to Diesel power.

This craft, formerly powered with 150-h.p. steam engine, is to be changed to 170-h.p. "Western-Enterprise" Diesel engine. It is estimated that a saving of more than 50 per cent in operating cost, and an increase of speed will be effected by this change over.

The IMPERIAL is but one of many large steam yachts in Pacific waters the owners of which are contemplating conversions of this kind, and many installations in new pleasure craft have been reported by Diesel engine manufacturers. The Puget Sound district, because of the particular suitability of Diesel power for the hundreds of small boats that are there, have been exceptionally responsive in adopting this economical motive power.

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The Passing of the Engine-Room Chair

Duties in the Machinery Room Outlined in a Clear Manner by One Who Goes Down to the Deep Sea in Ships

(Contributed)

NOT long ago I had the pleasure of visiting a new motor tug. Upon stepping into the engine-room I was immediately struck with a feeling of admiration for the thoroughness of the owner and designer, for it would appear that they had not overlooked a single item of importance. They had not; the job was perfect.

However, being an oil-engine man accustomed to deep sea work I was surprised to find a pair of nicely upholstered seats, conveniently located, in the upper engine-room: An ideal place for lounging and very inviting to the engineer on watch. All things of immediate importance such as controls and gauge board were within easy reach, and in clear view from that vantage point.

The Chief, a former steam engineer holding his first motor job, seemed to think these seats of almost as much importance as the main engine itself. Being unable to restrain myself I dug deep to bring up my most diplomatic and flowery style of English, and with it informed him that such seats would go by the board in short order if placed in an engine-room of mine: that with idle hours on his hands the watch engineer could spend his time more in accordance with the needs of the job, around a work bench, but that there should not be many idle hours. Being a very nice and mild-tempered sort he never kicked me out of the engine-room as he—according to all old traditions of the sea—should have done.

The most common questions, asked me by the laymen who visit the engine-room of a motor vessel, are these: Aren't motor engineers paid more than steam engineers? Don't they have to know more to be able to run one of these than to run a steam job? Which would you rather run, a triple expansion engine and Scotch marine boilers, or motors? Don't you honestly believe it is worth more to run a job like this than one on a steamship of similar size? To all of these I give the same reply, that an unbiased opinion is impossible with me for I am a 100 per cent motor enthusiast.

What I have observed along the lines of the popular questions is that motor engineers in general feel that they are worth more than steam engineers, but that steam engineers in general seem to think that just the reverse is the case. They are in common accord in their belief that neither are fully paid. Ship owners in general seem to think there is little difference between them and that they are all overpaid. This diversity of opinion is of great value in bringing about a suitable economic balance, but throws little light upon the subject in hand.

The settee and chair in the engine-room are fast passing—this in connection with the forward march of progress. The engineer who can not give these up may as well make up his mind to become a ticket chopper or cobbler where sitting down will be a part of his work. It surely is not a part of the motor engineers' work. Motor installations are becoming more and more numerous.

A steam engineer on watch at sea never spends his time in a chair, but if he is on an inland-waters steamer he often does. Therefore there is a difference in steam vessels and the men who run them. With motor vessels there is a similar difference, but not such a great difference in the men except in calibre.

A motor engineers' organization was recently formed in New York because as they expressed it, the deep water men and harbor men are constantly at outs. For the benefit of would-be motor-engineers and employers of these it may be well to cast some light upon the subject of what is required of them. To the experienced motor-engineer this will be no news.

Routine repair, or maintenance work must be carried out on both steam and motor vessels. On the former the bulk of this is hard manual labor, performed by firemen and wipers in punching flues, cleaning boilers and furnaces and other equally disagreeable and lowly tasks. On the latter this sort of labor has been almost entirely eliminated. However, other work of a finer class must be done. Work which must be done with care and precision and which is the task of a mechanic, not that of a fireman or wiper type of man. True enough there is not much of it, but what there is falls to the lot of the engineer and is sufficient to occupy his spare time.

Likewise the machinery in operation and under his care requires his painstaking attention. If it were merely oiling and feeling it would be a different matter. An erratic water supply to the main engine may cause as much damage as a similar supply to a boiler, barring the possibility of danger to life and limb. A change in temperature may bring about great stresses which if constantly repeated will cause serious damage. A smoking exhaust is not like a smoking stack, a sparking commutator is not like a leaking pump-rod, an automatic starter is not like a leaking throttle valve, when out of order. All of these things require the touch of a skilled hand controlled by a clear and alert mind. They need the attention of the engineer on watch while the oiler makes his regular rounds of oiling, feeling and wiping. They become second nature to men familiar with them.

While the matter of economy in operation is almost entirely taken care of automatically in oil engines, the matter of repair is altogether different and depends almost wholly upon the operating engineer, in his care and attention to duty and small details. It would probably be an easy matter for a steam engineer to explain away an increase in fuel consumption for a time, as the result of his not having watched his fireman closely, but it is a much more difficult matter for a motor engineer to explain away a scored or cracked cylinder or piston brought about as the result of a seizure which had resulted from carelessness on his part in watching temperatures or combustion.

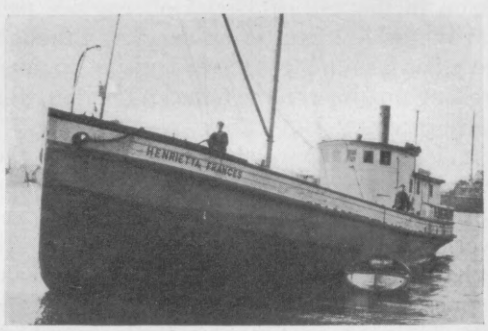
The machinery age has given us the oil engine, and with it economy, and new jobs. New types of men fill these jobs, men who have broadened their views and learning, improved their mechanical ability and taken a different attitude toward actual work. They have not found this hard. They like it and would not fill a steam engineer's place if they were given the chance—which, by the way, they will not.

This marks the passing of the engine-room chair along with the shovel engineer.

Oil-Engined Workboat in Southern Waters

One of the largest lumber dealers on the eastern shore of the Chesapeake Bay is the E. S. Adkins & Company, who operate sawmills, planer and joiner mills and are dealers in all kinds of building material. Their oil engined workboat, the HENRIETTA FRANCIS, has shown herself to be a valuable adjunct to their business.

She was built last year at Pocomoke City, Maryland, by E. J. Tull, and measures 92 ft. x 23 ft. x 8 ft. loaded and can carry 200 tons or 100,000 ft. of lumber. Her propelling plant consists of a 100-b.h.p. Fairbanks Morse engine which uses about 6½ gallons of 34° Be. fuel and 2 pints of Vacuum D.T.E. lubricating oil per hour. Auxiliary equipment includes a 32-volt 6-kw. Fairbanks Morse lighting plant running on kerosene and a 3-h.p. pumping engine for fire, deck and bilges. Another engine of the same make drives a double-drum cargo hoist of 6-h.p. which is capable of handling the heaviest materials. A 100-gallon fuel tank and accommodations for a crew of five men are also provided.



A valuable aid to a chain of sawmill and joiner works situated on Chesapeake Bay

Nothing has been overlooked in the building of this motor vessel and she has turned out to be a highly successful investment from every point of view. Since the time when she went into commission there has not been a moment's delay on account of machinery, and her owners have found her to be a handy boat for their large trade on the western shore of the bay. She carries the finished product and rough lumber.

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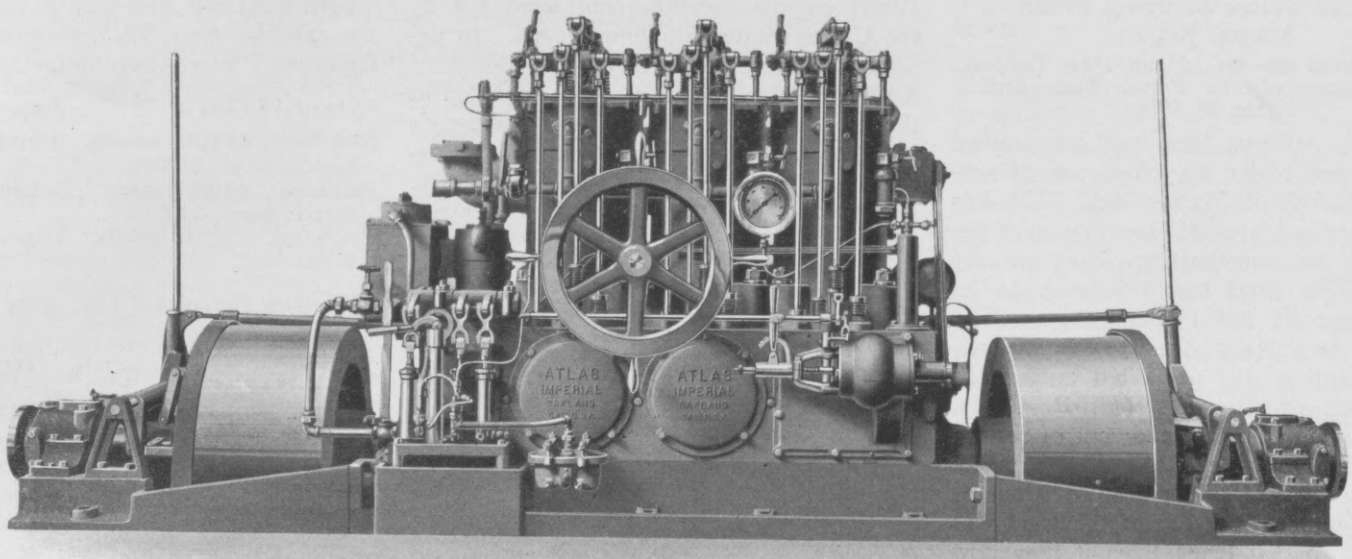


Oil engine especially adapted for ferry-boat use. Dual propellers of opposite pitches located at either end of the vessel make reversing simply a matter of throwing in the proper clutch, all engine reversing mechanisms being avoided

Engine for Ferries Has Clutch at Each End

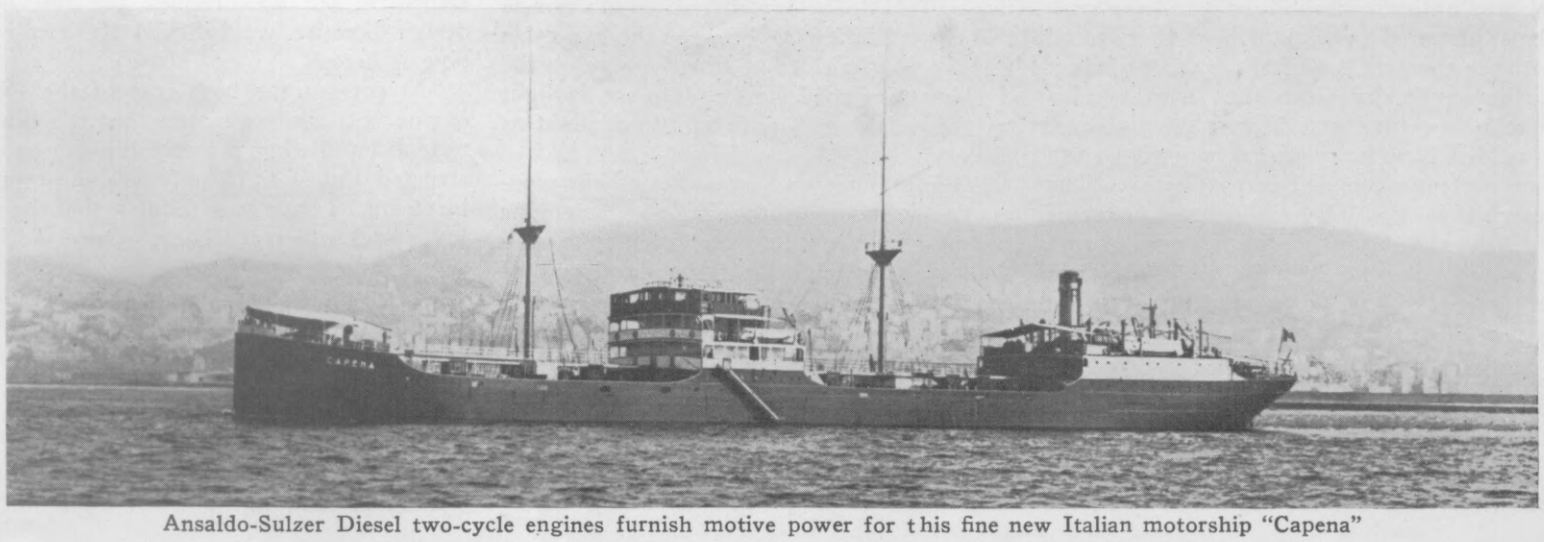
Astern Gearing Is Eliminated from the Clutch and the Engine Is Freed from Direct-Reversing Valve Mechanisms

A DOUBLE-CLUTCH engine embodying the same principles as the propelling plant used on the CHESTER H. BRYAN, described in a recent issue, is illustrated herewith. This is one built by the Atlas Imperial Company and is used by the Sherman Island Ferry on one of their boats running out of Antioch across the Sacramento River. Other installations of this kind are the notable VASHON ISLAND ferry of 250 b.h.p. which was put in operation 8 years ago and two ferries of 140 b.h.p. each belonging to the Long Bell Lumber Company.

Characteristic of the double-end arrangement is the elimination of the reversing clutch and the avoidance of the necessity of making the engine direct reversible. "Ahead" and "astern" propellers are naturally to opposite hand so that the reversal of the boat is accomplished by unclutching the one and throwing in the other. Naturally there is also a middle position for the clutch lever in which neither one nor the other propeller is engaged. It is a good deal less expensive to build a clutch than to make the engine directly reversible and full power is obtainable in either direction.

The 75 h.p. Atlas engine illustrated replaces a gasoline engine which formerly cost $12 per day, and even at that the labor of shutting down the latter and starting it up again each trip for the purpose of saving as much as possible had to be put up with. Since the installation has been converted to the oil engine type, the owner never shuts down his power plant from 8 o'clock in the morning until 6:30 in the evening, and his fuel bill is 80 cents per day. From $12 down to 80 cents represents an achievement which is bound to command widespread attention.

Further economies are made possible by the use of remote controls to the pilot house, as the result of which one man can handle the boat with ease, both as regards steering and maneuvering. The owner attends to the mooring and casting off and while the boat is under way, collects fares from the foot-passengers and automobilists. The double clutch system doubtless will solve the propulsion problems of many small ferries now building or contemplated.



Ansaldo-Sulzer Diesel two-cycle engines furnish motive power for this fine new Italian motorship "Capena"

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United States Shipping Board Annual Report

Extracts from the Board and Fleet Corporation's Reports of the Fiscal Year Ending June 30, 1924

"The construction loan fund, maintained by the Board under the provisions of section 11, Merchant Marine Act, 1920, has been under the immediate supervision of the committee on construction loans of the Board. This fund has a balance to its credit (June 30, 1924) amounting to $57,900,000. As a part of the work of supervision, legislation was promoted during the last session of Congress (H. R. 6202), which resulted in the amendment of section 11, Merchant Marine Act, 1920, by an act dated June 6, 1924, under the provisions of which amendment the use of the fund was broadened so that loans from it may now be made not only to aid in the construction of new vessels, but also for the outfit and equipment of vessels already built, with engines, machinery, and commercial appliances of the most modern, the most efficient, and most economical kind.

"During any interest period in which the vessel is operated exclusively in coastwise trade, or inactive, the rate of interest shall be not less than 5¼ per cent per annum. But for any interest period during which the vessel is operated in foreign trade the rate may be as low as 4¼ per cent per annum, but not less than that rate. The Board may prescribe rules for determining the amount of interest payable under the provisions of the act. In no case shall the total loan be for a greater sum than two-thirds of the cost of equipment and its installation for vessels already built.

"In the supervision of this fund the Board is as exacting with respect to security for the repayment of the loan as a private banker would be under similar circumstances. The only substantial advantage accruing to the borrower from this fund is the longer period for the payment of and the lower rate of interest on the loan, as authorized by law.

"Believing that the American Merchant Marine posseses too few passenger vessels capable of competing with the great liners under foreign flags, the Bureau of Construction recommended to the Board the preparation of plans, having in view the construction of two fine new passenger vessels and authority was given it to have such plans prepared; not, however, to proceed with the construction of the vessels, without further authority from the Board. This Bureau has employed Messrs. Gibbs Bros. (Inc.) of New York, to prepare plans, and they are now engaged in that work. The vessels if built will be of the general type of the steamship GEORGE WASHINGTON, but on an improved and enlarged scale. They will be equipped with internal-combustion engines."

United States Shipping Board's Conversion Program

Hull of classes 1013 and 1027 have been tentatively selected for the majority of the Diesel engines recently contracted for by the United States Shipping Board. In design 1013 there are eight available ships of 8,400 tons d.w. which were constructed at the Los Angeles Shipbuilding Company's yard and are at present equipped with geared turbines of 3,000 s.h.p. at 100 r.p.m. Drawings and particulars of these vessels appeared on page 32 of the Conversion Supplement to the October number of MOTORSHIP.

Design 1027 consist of 9,500 tons d.w. cargo ships built at the Oscar Daniels yard and there are nine of this class available. These ships have reciprocating steam-engines and Foster water-tube boilers of 2,500 i.h.p. at 78 r.p.m. Drawings and specifications were given on page 25 of our Conversion Supplement. There are a total of eighteen engines to be installed, so probably several ships of another class will also be selected, perhaps tankers.

Final contracts for the Diesel engines were mailed from Captain R. D. Gatewood's office at the Emergency Fleet Corp., New York, on December 17th, and it was anticipated that they would be signed by December 22nd. Specifications for the auxiliary machinery were almost completed at the time of closing for press with this issue of MOTORSHIP and are due to be dispatched by the 1st of January.

The Shipping Board and Diesel Power

An impromptu talk on Diesel drive for merchant ships was given at the New York Power Show by Capt. R. D. Gatewood, manager of the Department of Maintenance and Repair of the Emergency Fleet Corporation. "As far as the Shipping Board is concerned," said Captain Gatewood, "we have nothing to sell and a lot to buy. The Board is not interested in any particular engine as such, or in any type. We are solely interested in the possibility of putting Diesel engines in existing ships, with all their limitations in space, at a cost that will leave us some chance of getting our money back. It is almost solely a question of cost.

"If we can get an engine that has real business possibilities we could put Diesel engines in 200 ships, starting to-morrow. But in so far as the weight and the consequent cost are concerned it does not look as though single-acting engines were now, or were likely to be, much improved; nor is there much difference between the two-cycle and the four-cycle; but when you go up the double-acting road you begin to see daylight on the weight and quite a little daylight as to cost.

"It is my opinion that as far as our present fleet is concerned the single acting engine has absolutely no future at such time as a double-acting engine can be developed of equal reliability. Compared to the double-acting principle, the single-acting engine doesn't seem to be 'in the wood.'"

Board's New Fuel-Oil Contracts

The following awards for furnishing fuel and cargo oil requirements for Shipping Board vessels at Atlantic and Gulf ports for the calendar year, 1925, were made by the Emergency Fleet Corporation today:

**Standard Oil Co. of New Jersey. Fuel Oil.*

New York, 4,200,000 barrels. Terminal, $1.79 per barrel; barge, $1.85½.
Baltimore, 960,000 barrels. Terminal, $1.79 per barrel; barge, $1.85½.
Charleston, 180,000 barrels. Terminal, $1.74 per barrel.

**Mexican Petroleum Co., New York City. Fuel Oil.*

Jacksonville, 198,000 barrels. Terminal, $1.70; barge, $1.76½.
Houston, 198,000 barrels. Terminal, $1.50.

*Prices quoted are maximum and are subject to decline in suppliers' market prices.

Magnolia Petroleum Co., Dallas, Tex. Cargo Oil.

Beaumont, Magpetco and Sabine, 1,300,000 barrels. Terminal, $1.45.

British Shipbuilder Talks to American Shipping Men

At a recent luncheon at the Propeller Club, Sir George Hunter, Managing-director of Swan, Hunter & Wigham Richardson, the well-known British shipbuilders, was guest of honor and gave a very interesting talk. One thing which struck him very forcibly on his fourteenth visit to the United States since 1885 was the abounding prosperity of this country and that our great advantages are added to by the resourcefulness and energy of the American people.

Dealing with the question of ships and the future of shipping, Sir George said that he frankly believed that the only hope of shipbuilding lies in the economies which can be effected in operating ships constructed to burn oil—not as fuel under boilers but in the Diesel engine. In fact, there would not be enough oil to go around if all the ships crossing the Atlantic were to burn oil under their boilers.

"My own company," added Sir George, "is giving a great deal of attention to the two-cycle Diesel engine at our Neptune plant and is developing the two-cycle double-acting design at our North British Diesel Engine plant. We built the four-cycle Diesel engine of one of the first two large ocean-going motorships, namely the JUTLANDIA built at the Barclay Curle yard, sister to the SELANDIA built by Burmeister & Wain in Denmark, but we dropped the four-cycle design because we believed the two-cycle type is better.

"At present the high cost of the Diesel engine is a serious matter, but the time is near at hand when a motorship can be constructed almost as cheaply as one propelled by steam. I have long thought that the sailing vessel will come back. Once we built seven sailing vessels for every single steam craft, but late years we have built almost nothing but steam and motor vessels. We shipbuilders can only hope to return to prosperity through the adoption of the Diesel engine, and through the adoption of sails."

As regards the Flettner rotor-ship, Sir George said he must frankly say he does not understand it.

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Dutch-Built Nobel Diesel Engine

Two-Stroke Cycle Used for Developing the Moderate Power of 900 s.h.p. in a Short Four-Cylinder Unit with All Auxiliaries Beam-Driven at the Side.

MUCH is to be said on both sides of the question as to whether an engineering firm which contemplates the manufacture of Diesel engines should acquire the license for an already established make or develop its own design. On the one hand, a certain cash consideration is involved and everyone likes to feel that he can do at least as well as the other fellow. On the other hand, it takes a certain amount of time to develop manufacturing practice for any new line of machinery, be it corkscrews or compressors. The delay and expense incidental to more or less unavoidable experimentation with newly-conceived designs are apt to outweigh the costs of a license by a considerable amount. The possibility of concentrating into a few months' or years' time experiences which others equally well equipped have taken decades to accumulate is likely to be questionable. Furthermore, every Diesel license means one less different design on the market and a step nearer standardization than otherwise would be the case.

A decision in favor of adopting a license was reached by the Burgerhout's Engineering & Shipbuilding Company, of Rotterdam, who are building engines of the Swedish Nobel Diesel Company. The latter firm, it will be remembered, is the one which pioneered the Diesel engine industry in Russia prior to the revolution and which made history during the early experimentation with Dr. Diesel's first designs. An extended account of this remarkable firm and their product was printed in MOTORSHIP for July of this year; a description of the first engine built by them since the World War, the 4-cylinder 2-cycle 1,600 s.h.p. unit for the motortanker ZOROASTER will also be found there. Articles also appeared in earlier issues.

The engine recently completed from their designs by Burgerhout's resembles the ZOROASTER's motor in a number of details, the chief difference being that of size. Principal dimensions of the latest Nobel engine are as follows:

Power	900 s.h.p.
Speed	94 r.p.m.
Bore	20.82 in.
Stroke	37.40 in.
No. of Cylinders	4
Weight	123 tons

Not only the injection-air compressor and scavenging pumps, but also all the other auxiliaries essential to the operation of the engine are direct-connected. Beam-drive is employed for the compressor and scavenging pumps, as well as for the piston-cooling and main circulating water pumps, bilge-pumps and the usual accessories required by the vessel while at sea.

The first unit built at the Burgerhout shipyard and installed on the testbed for an eight days' public test under the supervision of independent experts is the first two-stroke Diesel engine constructed entirely in Holland. It has been built under special survey of the Dutch Shipping Inspection, Lloyd's Register and the Bureau Veritas, and has been designed for installation in a cargo ship. It is a four-cylinder, direct-reversible engine of the crosshead type, the scavenging, injection-air and cooling water pumps being driven direct from the main engine crossheads.

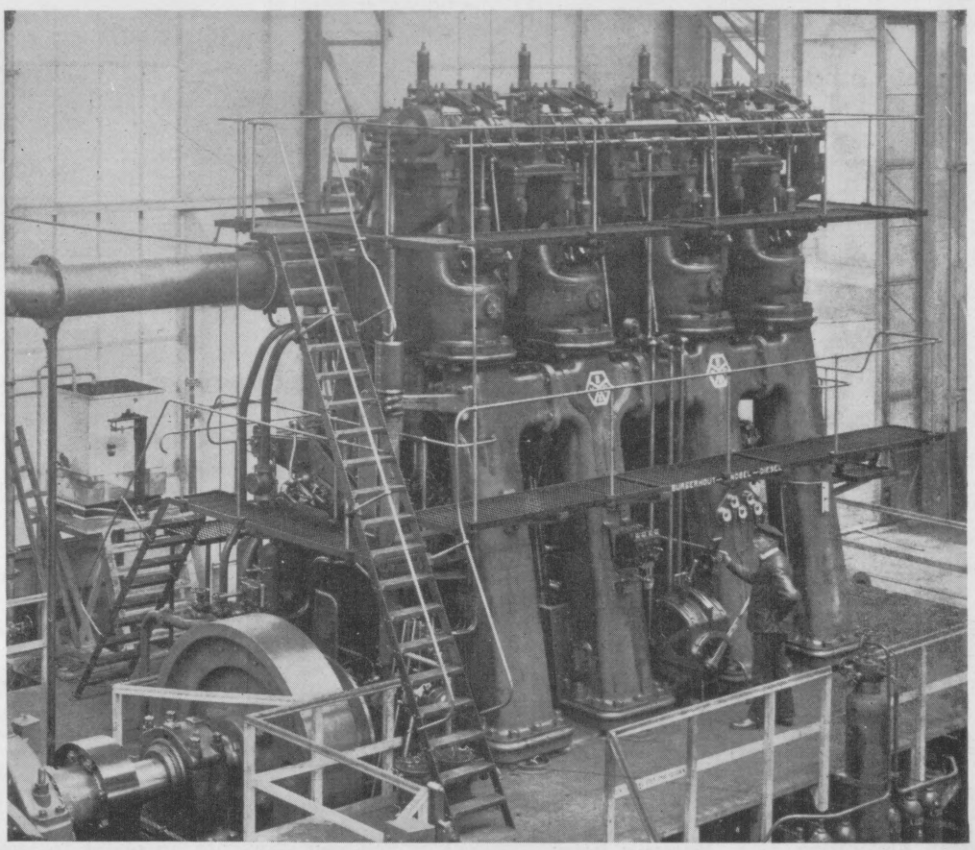
It is of the slow-speed, long-stroke type, with the cylinders 21 inches in diameter by 37½ inches stroke, and develops 900 s.h.p., corresponding to 1,125 i.h.p., at 94 r.p.m., with 71 lbs. per sq. in. mean-effective pressure. The bedplate is made of two parts bolted together, carrying front and back columns which are rigidly joined together at the top ends. Each pair of cylinders is coupled together, and the crankshaft, having a diameter of 13½ inches, is of the built-up type, the two halves being joined together at an angle of 90°, and the two cranks of each part being directly opposed so that the order of firing is 1-4-2-4 ahead and 1-4-2-3 astern.

Water-cooled box-type crosshead guides are fitted and crossheads of the ordinary marine type with connecting-rod ends forged and carrying cast-steel crosshead bearings lined with white metal. Scavenging and cooling water pumps and air-compressors are driven by beams from the crossheads, No. 1 crosshead driving the l.p. and h.p. air compressor arranged on top of each other, and a double set of water-circulating pumps. Nos. 2 and 3 crossheads each drive a double-acting rotary-valve scavenging air pump while the i.p. compressor and an auxiliary set of scavenging pumps are actuated by No. 4 crosshead.

Sea water is used for all cooling, large mud and inspection doors being arranged at suitable places, while zincs are provided to prevent the corrosion of vital parts. Pistons are fitted with solid rings and the lower piston skirts cover the exhaust and scavenging ports while the piston proper is moving near the upper end of the stroke. A single central fuel valve is provided in the top of the head, while starting and compression-relief valves are located on either side of it. Cast steel is used for the head. "Bumped" heads are used for the pistons and in combination with the approximately hemispherical under-side of the cylinder heads, produce a combustion space of a shape calculated to produce even fuel distribution.

Since only light valves are employed on the engine, reversing can be carried out by hand and the reversing servomotor dispensed with. The discharge from the compression relief valves is piped to the scavenging air spaces (hollow frame-columns) with the result that the scavenging air pressure is quickly built up while starting. A piston valve of the grid type is used for the control of the scavenging ports, as was fully described in MOTORSHIP for December of last year. The amount of its opening, as will be recalled, can be varied by hand to meet the conditions for starting and slow running.

C. Curtis, of *Saturday Evening Post* fame, is having his steam yacht LYNDONIA converted at the Cramp Shipyard, Philadelphia to Burmeister & Wain type Diesel power of 1,700 aggregate i.h.p. There will be two 50-k.w. Diesel-driven B. & W. sets as auxiliary power.



The Burgerhout-Nobel Diesel engine in the erecting shop at Rotterdam

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Our Readers' Opinion

(The publication of letters does not necessarily imply Editorial endorsement of opinions expressed)

America's Development of Air-Craft Oil Engines

To the Editor of Motorship:

It has been some time since I have had any correspondence with you, but I could not resist the desire to express my approval of the sentiments expressed in your editorial in the November, 1924, issue of Motorship. I agree with you that there is entirely too little attention being paid to the development of the fuel-injection engine having the characteristics of high-speed, high specific power output and high fuel economy. If we in this country do not very soon come to a proper realization of the matter, we will find ourselves hopelessly left behind by the developments in this general type of engine in several European countries.

Your article in *Oil Engine Power* for November, 1924, describing the Maybach high speed automotive Diesel engine is very interesting to our people as direct evidence that our own fuel injection research work is not headed in an unpromising direction. The disturbing aspect of the matter is that the development of this general type of engine has progressed so much further abroad than it has in this country, a situation which we should make every effort to correct. Further information on this and similar developments is eagerly awaited.

Leigh M. Griffith,

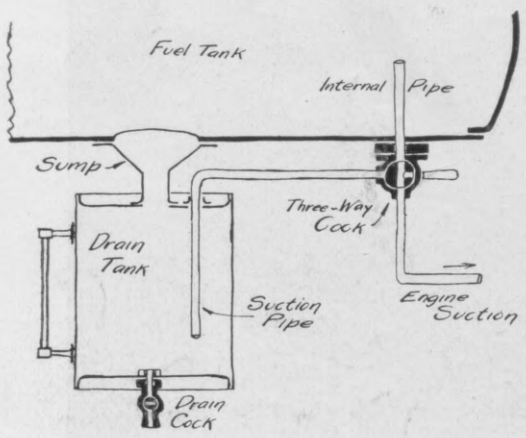
Engineer-in-Charge, National Advisory Committee for Aeronautics, Langley Field, Hampton, Va.

Draining Fuel Tank of Water

To the Editor of Motorship:

The trouble of water getting into the fuel and its effect on the engine, especially in the case of an emergency, calls for some system of drainage. Much delay and damage may be caused by a boat having to stop until the oil pipes have been cleared. Even then, if there is no effective method of carrying out this operation, the pipes are likely to become water-logged again.

This condition may exist in small coasters, tugs, or fishing craft where heavy-oil engines are employed and through want of space there is no settling tank. In the sketch, an attachment is shown which can be fitted to an ordinary storage tank and which in itself takes up little room in the boat; the expense also being much less than it would be for a settling tank.



Sketch illustrating J. F. Russell's letter

The attachment is constructed in the following way and could be made by any small firm or handy man wtih a few tools. By having a hole cut in the bottom of the storage tank, a sump-like arrangement is fitted. Secured to this sump is a piece of short tube, which extends into the top flange of a small drain tank; the bottom flange of this tank is provided with a drain cock, so that the water collecting in the tank can be drained off. An internal pipe being fitted into the storage tank, as shown, and about one-third the height of the tank in length, will insure the oil being free from water, especially just after fueling and if heating steam is provided and put on, the water will collect and fall into the drain tank and there can be drained off by the cock. This cock is also useful for testing for the presence of water in the oil.

Attached to the bottom of the storage tank and in communication with the internal pipe is a three-way cock, with another branch communicating with the drain tank by means of a pipe, while the third branch leads the fuel supply to the engine. When the fuel falls below the level of the internal pipe, the cock can be switched 'round, so that the engine will draw its supply from the bottom of the drain tank, the water having been drained off first; this arrangement allows of getting all the oil available in the tank which may be called for in case of shortage or delays by bad weather. By fitting a gauge glass, the presence of water can be seen without opening the cock and running oil into the bilges, if there should be no water present.

The construction of the attachment could be done either by soldering, brazing, or, if a substantial job is wanted, riveted together. Solder is not so serviceable where vibration from the engine might cause it to come apart, thus causing loss of oil.

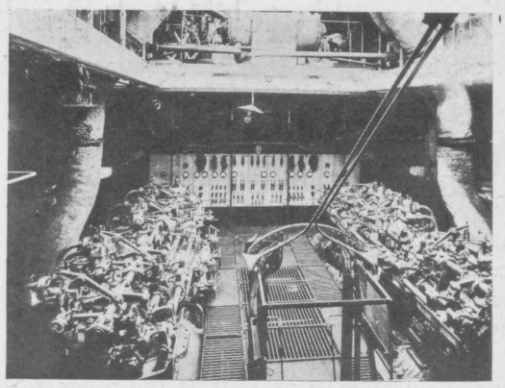
Very truly yours,

J. F. Russell.
S.S. "Pinar Del Rio."
c/o American & Cuban Co.,
New York.

[We are in agreement with you that effective provision for the removal of water from the fuel-oil is an essential part of every motorship's equipment. The fitting of the riser inside the fuel tank is also generally regarded as a necessity, in spite of the loss in tank capacity which it entails.

As we understand your letter, your object in fitting the auxiliary drain tank is, first, to avoid this sacrifice in main tank capacity and, second, to prevent a continuous re-mixing of the oil and water, such as would result if there were no positive separation between the main contents of the tank and the portion intended for drainage. It would appear as though caution would need to be exercised in manipulating the three-way cock which you illustrate, in order to avoid inadvertently feeding the undesirable contents of the drain tank into the fuel pump of the engine. It is conceivable that the engine might unexpectedly stop, due to the arrival of the main-tank oil level at the mouth of the main-tank riser. If the vessel happened to be in a position where loss of headway might be disastrous, someone would be likely to throw over the three-way cock in a hurry, without first patiently draining the muck and water out of the drain tank. The chances are that the engine would then stop anyway, beyond all possibility of immediate re-starting.

Have you considered the use of a centrifugal purifier for the fuel oil? It makes available high power for the positive extraction of water and impurities, to a degree which is far beyond the possibilities of any gravity arrangement.—*Editor.*]



Engine room and switchboard on motorship "Capena," illustrated on page 35

A Question of Propeller Design

To the Editor of Motorship:

In your July number of Motorship the statement is made that the boat, Katherine, equipped with a 45 h.p. Fairbanks-Morse C O engine turning a 42-inch by 26-inch pitch propeller, makes 10 knots.

A 45 h.p. C O engine is rated at 400 r.p.m.

$$\frac{400 \times 26 \times 60}{12} = 52{,}000 \text{ ft. per hr.}$$

$$\frac{52{,}000}{6{,}080} = 8.55 \text{ knots}$$

This shows that the boat is running away from the propeller to the extent of 1.45 knots, or close to 14.5 per cent negative slip.

Viggo Steffensen.

755 4th Street,
San Pedro, California.

All the Way from Australia

To the Editor of Motorship:

We must congratulate you on your magazine, Motorship, as we think it the finest journal of its kind, and the matter contained therein is very eagerly consumed by all our staff.

Alvin Taylor.

Alvin Taylor, Ltd.
Sydney, N.S.W.

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(Editorial section continued on page 43)

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Swedish Motorship Construction

Götaverken Activity Includes Supercharging Engines, and the Conversion of a Steamer

Considerable activity in the construction and fitting out of motorships has been apparent at the Götaverken, of Gothenburg, Sweden, during the year which has passed. Reference has already been made in these columns to the 10,000 ton ships NANKING, OXELSUND and NUOLJA, to the 5,000-ton Nobel-engined tanker ZOROASTER, and the Norwegian-built Götaverken-engined INNAREN, also to the 4,000 i.h.p. Diesel-driven, oil-carrier PAJALA, which has just run trial.

American passenger motorships, too, have recently been built at the Götaverken, notably the CITY OF SAN FRANCISCO, already described, and her sistership the CITY OF PANAMA, of the Pacific Mail Line, just put in service.

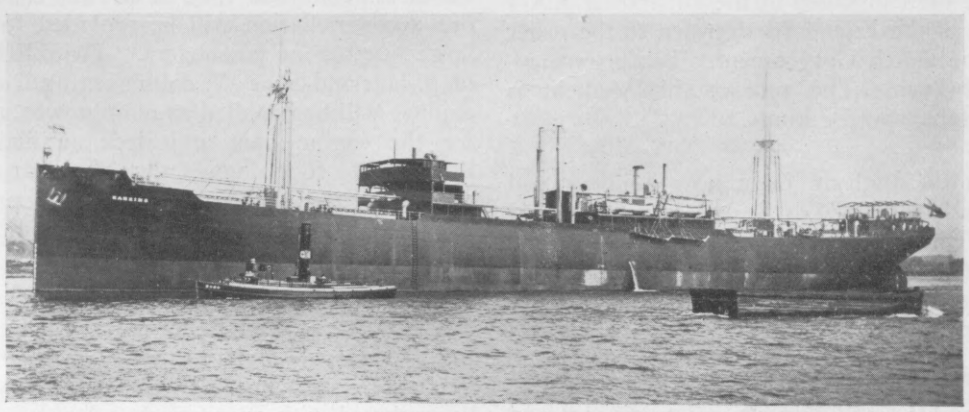
Hugo Hammar, managing-director of the Götaverken, who recently visited the office of MOTORSHIP advised us that they now have four motorships on the stocks and another on order. For the Trafikaktiebolaget Grängesberg-Oxelösund there is building a 7,500 tons d.w. three-island type ore-carrier equipped with a single-screw Götaverken B. & W. Diesel engine of 2,600 i.h.p. and a sister motorship will shortly be started.

The keel has also been laid at the Götaverken for a 5,000-ton motorship of the Swedish-American Line to be operated in the New York route. She will be propelled by a single Götaverken-B. & W. long-stroke engine developing 2,000 i.h.p. in six cylinders of 24.80 x 51.18 inches bore and stroke at 100 r.p.m. A notable feature of this installation is the use of supercharging, as the result of which an m.i.p. of 107 lbs. per sq. in. will be attained.

One 7,500 tons d.w. 3,400 i.h.p. twin-screw motorship with long-stroke, Götaverken-B. & W. Diesels have just been ordered by the Swedish East Asiatic Co., these vessels being sisters to one now on the stocks for the same owners. As they will carry both passengers and cargo they will have stacks, contrary to usual Swedish practice.

Then there are the two 7,100 tons, 3,400 i.h.p. combination passenger-cargo motor liners ordered from the Götaverken by the Axel Johnson's Pacific Ocean Line of Stockholm, as reported in our November issue.

Converting steamers to motorships, although receiving the greatest amount of attention in the United States, is not altogether unknown on the other side. Europeans have prided themselves on the fact that their steamships are so efficient as compared with American vessels that the gain realized from conversions is not sufficient to pay for the cost, but this claim does not appear to be taken seriously by the Trafikaktiebolaget Grängesberg-Oxelösund. As previously announced in MOTORSHIP, they have commissioned Götaverken to tear out the steam machinery of the 9,000-ton ore-boat VOLRATH THAM, and to replace it with a 2,600-i.h.p. long-stroke Diesel engine of the dimensions already given.



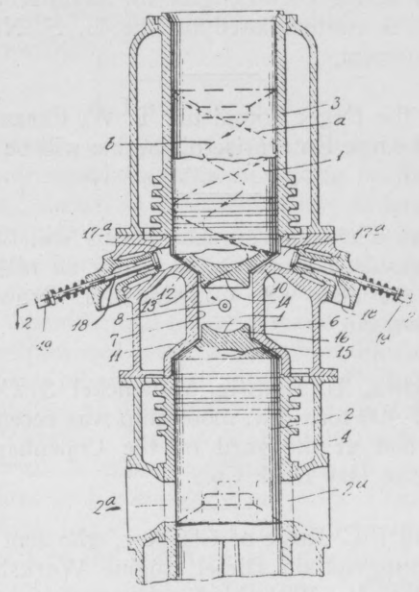
10,000-ton cargo-carrier "Nanking," a sister ship of the "Nuolja," recently left the Götaverken Yards after having been equipped with Swedish-built B. & W.-type Diesel engines

Motorships for Siamese Ministry of Commerce

Reference was recently made to bids called from American and European shipbuilders by the Siamese Ministry of Commerce on two motorships for the Bangkok coastal trade. Bids are to be opened during the coming summer. Further particulars regarding these vessels are now to hand from the Borneo Company, Ltd., of London, which has issued specifications as follows:

Deadweight capacity	3,200 tons
Passenger capacity	10 first-class, 10 second class
Power	1,600 i.h.p.
Speed on 15′ mean draft	11½ knots
Length	295′
Breadth	43′ 6″
Depth moulded	20′
Loaded draft, mean	19′

Propelling power is to consist of two 6-cylinder, 4-cycle Burmeister & Wain crosshead type Diesel engines each developing 800 i.h.p. at 130 r.p.m. So far as we have knowledge, Burmeister & Wain do not today construct a crosshead engine of this power for marine purposes, believing that the trunk-piston engine even in higher powers than this is amply reliable and is cheaper and lighter. The deck machinery will be steam driven and a 10′ 6″ by 10′ donkey-boiler with 150 lbs. working pressure is to be installed.



Vortex scavenging to produce turbulence during combustion process. The valves are tangential

Vortex Scavenging for Oil Engines

In an invention recently patented by Wm. Huskisson, formerly managing-director of Crossley Bros., Manchester, England, and during the last few years a representative in New York City of Vickers, Ltd., of Barrow, England, means are provided for producing turbulence in the combustion air of an opposed-piston oil engine, which have, in a large number of instances, been made to operate on the air-less-injection system and in which heretofore no special effort has been made to secure agitation of the burning charge. Scavenging valves are so located as not only to give the required slant to the air streams, but are also placed tangentially to the cylinder bore. They consequently impart an active whirling motion to the fresh air charge and it is claimed that some of this movement persists until after the air has been compressed.

Another feature of the invention is the construction of the cylinder liner at the point where the fuel-injection valve is located. If the same clearance volume as the normal one is retained, the combustion chamber becomes correspondingly longer and a combustion space of less attenuated form is obtained. It is easier, also, to make the small-diameter portion stronger and at the same better capable of being water-cooled.

After running very satisfactory trials the twin-screw motorship COMLIEBANK built by Harland & Wolff's Govan shipyard was delivered to her owners, the Bank Line, Ltd. This vessel is of 5,200 tons gross, and is propelled by two 6-cylinder Harland B. & W. Diesel engines.

Diesel and surface-ignition marine and stationary oil engines are to be built at the Canadian-Vickers plant in Montreal.

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Interesting Notes and News From Everywhere

World's Record of New Construction, Ships' Performances and Other Matters of Note in the Motor Vessel and Oil Engine Industries

DEVELOPMENT of a large double-acting Diesel engine for naval service is contemplated by the U. S. Navy Department.

In the Puget Sound tug T. W. FREETHY a 125 s.h.p. Enterprise oil engine will be installed.

Max Fleishman's yacht HAIDA will have her gasolene motor replaced by an oil-engine, as also will Courtland S. Brown's WINDWARD.

HEINA, L. Ludwig Mowinckel & Co.'s new 7,400 tons d.w. motorship was recently launched at the yard of the Copenhagen Floating Dry Dock Co.

Will J. C. Rosie of Glasgow, who sent us a manuscript on Diesel Engine Workshop Problems in 1921, kindly forward his address to this office of MOTORSHIP?

Two 75 h.p. Kahlenberg oil-engines will be installed in the 104′ steel ferryboat building at the Tampa Dock Company for the Bee Line Ferry Company.

Two more Winton-Diesel engined tugs are to be built for the Wilmington Transportation Co., and the hulls will be constructed at Wm. Muller's yard at San Pedro, Calif.

FERNCLIFF, the second of three sister ships building for Messrs. Fearnley & Eger of Christiania at the Deutsche Werft, was due to be delivered to her owners during December.

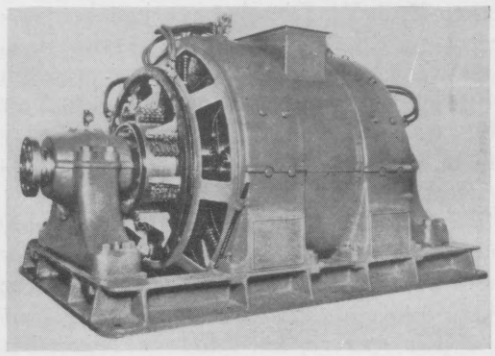
The 1,600 tons motorship EPICA built to the order of Gorrisen & Co., Christiania, has just left the builders' yard on her trial trip. This vessel was constructed by the Karlshamn Skibsverft.

AKIBASAN MARU, another motorship for Mitsui & Co., was launched early in December. She is somewhat different in design to the AKAGISAN MARU recently illustrated and described in MOTORSHIP.

CONSUL HORN, sister 4,600 tons d.w. motorship to the THERESE HORN was lately launched at Krupps yard in Kiel. She is equipped with a Flettner rudder and will operate in the West Indian service.

For the South American service the Hugo Stinnes Line has placed an order for two large motorships—one with the Weser Co., Bremen, and the other with the Vulcan Shipyard at Vegesack.

Six big motorships are shortly to be ordered by the recently organized Yamashita Line, which is composed of the Nippon Yusen Kaisha, the Osaka Shosen Kaisha and the Eastern Australian Line.



Propelling motor of Standard Oil of Cal.'s new Diesel-electric tanker

Work may shortly be commenced by the New York Shipbuilding Corporation on a six-cylinder 28.74″ by 51.18″ four-cycle double-acting Werkspoor Diesel marine engine of 3,320 s.h.p. The drawings are practically completed.

Diesel engines are contemplated for propelling the six shallow-draft gunboats to be built for the U. S. Navy's China service, but it has not yet been decided as to whether or not the engines will be constructed in private or government plants.

Two 1,200 s.h.p. M.A.N. Diesel engines have been installed in the submarine KX-1 built at the Fijenoord shipyard to the order of the Dutch Government. Trials were recently run. The surface displacement is 821 tons, speed 7 knots.

In the tugboat JANE now building and recently launched at Seattle to the order of the United Dredging Co. of Los Angeles, a 200 s.h.p. Union Diesel engine will be installed at Oakland, where the vessel will be shipped.

The wages of a Swedish 8,000 tons d.w. motorship, including officers, engineers and crew, a total of 31 men, are $17,898 per year. The wages of the United States Shipping Board motorship WILLIAM PENN, of 12,000 tons d.w. total $42,702 for the 37 officers, engineers and men carried.

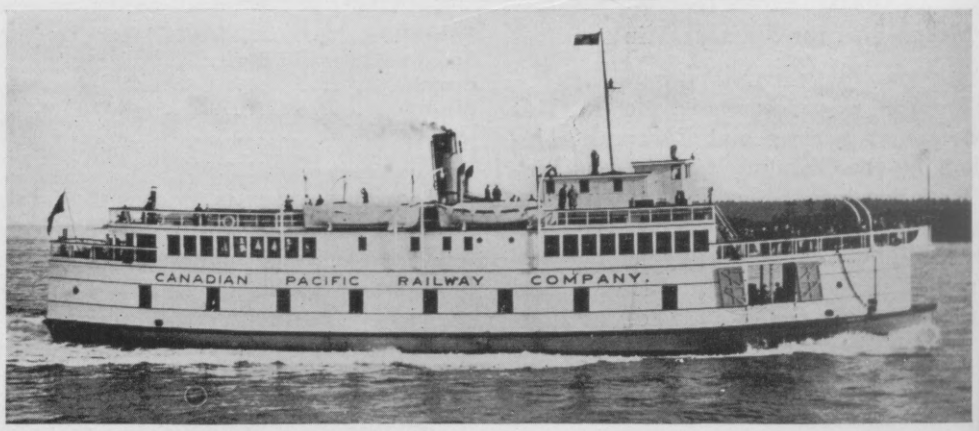
Two Italian shipyards recently quoted $43 and $45 per d.w. ton respectively on a 12,000 tons, 3,000 h.p. twin-screw Diesel-driven collier, while a third Italian yard quoted $50 per ton on a 11,000 tons Diesel-engined collier. These prices are considerably below prices for motorships in other European countries.

We have been advised by Krupps that the article on the performance of the motorship ZOPPOT published in our July issue, did not represent the complete mileage of this vessel as it incorporated the figures from lightship to lightship and not from dock to dock, the total mileage from dock to dock up to July, 1924, being 246,286 nautical miles.

"Fitting Diesel engines in ships has the effect of altering the longitudinal position of the center of gravity of a ship compared with a corresponding steamer and this in turn affects the longitudinal B.M. The pitching moment is reduced, easier movement in the seaway results and less power and fuel for the same speed are required." —*J. McGovern, Managing Director, Furness Shipbuilding Company.*

Dimensions of the new 20,000 tons gross motor-liner CARNERVON CASTLE now building by Harland & Wolff for the Union Castle Line are 630′ x 73′ x 46′, and luxurious accommodation will be provided for a large number of passengers. Twin 10,000 i.h.p. Harland-B. & W. double-acting Diesel engines will be installed as main power, and for the engine-room and deck auxiliaries there will be four single-acting Diesel-driven generators installed in a separate compartment forward of the main engine-room.

Construction work is proceeding on the two 22,000 tons gross motor passenger-liners for the Royal Mail Line at Harland & Wolff's Belfast yard. These fine craft will be equipped with every modern luxury and convenience, as well as having large accommodation for refrigerated cargo. As previ-



This McIntosh & Seymour engined Diesel ferry is one of the many of this kind that have made good

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ously stated the propelling power of each ship will consist of two sets of eight-cylinder four-cycle double-acting Harland-B. & W. Diesel engines together developing 20,000 i.h.p. Dimensions are 655′ 8″ x 78′ 6″ x 74′ 0″.

Jacob M. Heath, a steam-driven tugboat owned by the Stanwood Towing Co. of New York, is to be converted to motor power. Her owners have ordered a 220 s.h.p. four-cycle type Nelseco Diesel engine, and the work of installing the machinery will be carried out at the Groton, Conn., plant of the New London Ship & Engine Company. It is expected that the tug will be placed in commission in New York Harbor and Rockaway Beach early in March next. This is the second motor tug to be ordered by this company as they already operate the Wm. J. Conway, Jr., which has a 120 s.h.p. Nelseco Diesel engine. Her satisfactory performance justified the owners in their decision to convert the Jacob M. Heath.

Among the motorships now building at the Cantiere Navale Triestina, Monfalcone, Italy, which plant is owned by the Consulich Line, are two 8,500 tons motor freighters for the Consulich Line's service. One of these ships will have twin four-cylinder two-cycle Fiat Diesel engines of 1,300 s.h.p. each at 110 r.p.m. The other vessel will have a single eight-cylinder four-cycle Burmeister & Wain type Diesel engine of 3,560 i.h.p. at 95 r.p.m., which is being built by the B. & W. licenses the Stabilimento Tecnico Triestina of Trieste. The Fiat engined vessel will have a deadweight capacity of 8,700 tons while the B. & W. ship will have a deadweight capacity of 8,500 tons. The dimensions in both cases are the same, namely, length 390′, breadth moulded 53′ 9″, depth 32′, draft 25′ 10″. It is interesting to note that the electrical machinery for the engine-rooms and decks are being manufactured at the shipbuilder's yard.

"Tungsha's" Machinery Foundations

As the seventh of a series of highly standardized motorships, the twin-screw freighter Tungsha will be carefully studied by those who welcome all indications which point towards a stabilization of motor vessel technique. Beginning with the Tennessee and the Tiradentes, fully described in previous issues of Motorship, a total of eight vessels, all of this type, are ultimately to be delivered by the Deutsche Werft with A.E.G.-built Burmeister & Wain Diesel engines.

General dimensions of the Tungsha are as follows:

Length bet. perpendiculars	424 ft. 0 in.
Breadth	55 ft. 0 in.
Height to shelterdeck	38 ft. 6 in.
Deadweight	9,520 tons
Total power (2 engines)	4,000 i.h.p.

Since the power plant of this ship is a duplicate of that on the Tiradentes, fully described in Motorship for March, 1924, it is not necessary to repeat details here beyond recalling that the normal rating of the six-cylinder engines is 1,550 s.h.p. at 125 r.p.m. with bore and stroke dimensions of 24.8″ x 37.8″. As the result of using a supercharging blower, the power of the Tiradentes was increased from 3,100 i.h.p. total to 3,600 and on the Tungsha an intensified use of supercharging will bring the engine output up to 4,000 i.h.p.

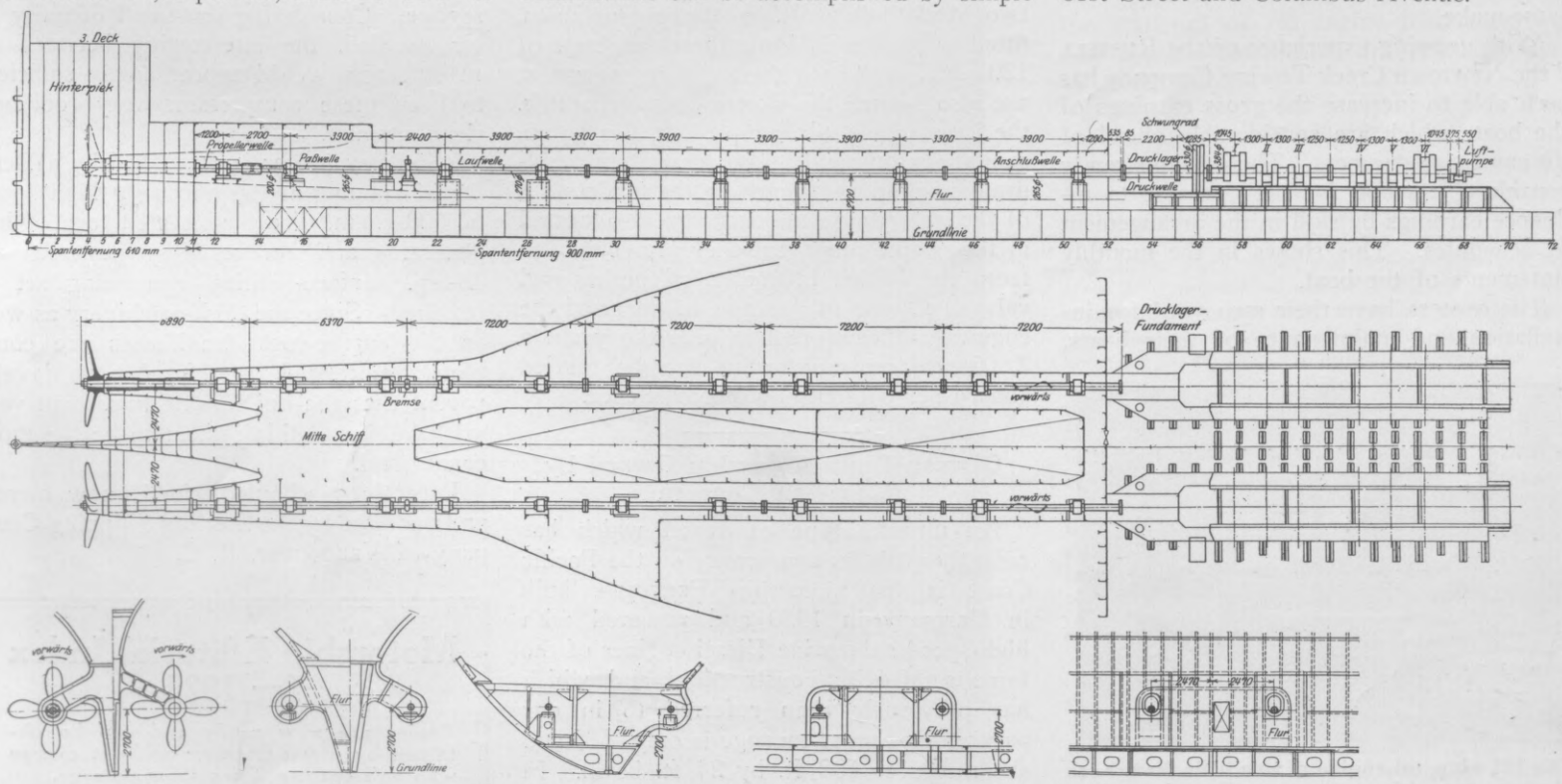
An unusually clear illustration of the method of locating modern motorship machinery in a ship is reproduced herewith through the courtesy of Werft, Reederei Hafen (Issue of October 7, 1924). It shows that the provision of adequate engine foundations can be accomplished by simple and direct methods. In view of the fact that the Tungsha is the seventh ship of the Tennessee-Tiradentes series, it is probably safe to say that the results from the thorough try-outs on the earlier vessels fully support the installation methods depicted herewith.

A Boost from Alaska

Lester Campen, Chief-Engineer of the motor-vessel Carmen operating in Ketchikan, Alaska, says he would like to have his name put on the top of the list as an oil-engine booster. The craft on which he has charge of the machinery is a 60′ length by 16′ breadth mail passenger and freight carrier powered with a 60 s.h.p. Fairbanks-Morse oil-engine turning a 43″ diameter propeller at 400 r.p.m. and drives the boat at 9 knots. The run is about 400 miles and is made in three days including 15 stops en route, and completely encircles Prince of Wales Island. Parts of the trip are exposed to the ocean so at times the boat is subject to a good shaking up. At times the engineers have had 6″ of water on the floor due to a sea washing aboard, but the engine has never missed an impulse, although sometimes there is difficulty in keeping the water out of the lubricating oil as the sea comes pouring down the skylight.

About three months ago the Carmen was sunk in the Portland Canal on the Alaska-Canadian boundary. Within an hour after raising the vessel the oil-engine was turning over as if nothing had happened.

The American Marine Association have finally completed plans to hold their 1925 Marine Show from November 9th to 14th, 1925, in order to coincide with the annual meeting of the Society of Naval Architects and Marine Engineering. It was necessary to change the location to the Armory at 61st Street and Columbus Avenue.



Foundations and propeller shaft installation of M. S. "Tungsha," which is propelled by twin A. E. G.-B. & W. 6-cyl. 630 x 960 mm. engines developing 2,000 i.h.p. each with superchargers. Note the construction of the engine foundation and the method of mounting the shafts

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Two More Towboats for New York Harbor

Aligning itself with the progressive movement towards oil-engine power, the Newtown Creek Towing Co., of Hunter's Point, one of the more important towboat operators in New York harbor, some time ago ordered Diesel equipment for a couple of tugs.

One of the boats was converted from steam; the other was built specially for the engine. The latter, christened RUSSELL 3 and now fitted out, was designed as small as her engine and fuel supply would permit. She will have a Lombard six-cylinder reversible engine of 375 s.h.p.

In her installation is incorporated the fruit of some of the experience gained by the company with the first, and smaller, of their motor towboats, RUSSELL 2. Originally built in 1901 as a steamer, and since rebuilt, this boat has a four-cylinder Lombard engine of 120 s.h.p. driving through a reversing clutch. This power is ample for her size, she being only 42 ft. 9 in. on the keel, with 14 ft. 2 in. breadth and 6 ft. 5 in. depth registered, the gross tonnage measuring 20 tons.

Since her commissioning in September, she has been working regularly on the Creek and in the harbor. Her assignments have altered considerably in character, as her capabilities have been tested. On the Creek and elsewhere—as in Flushing Bay, for instance—there have been occasions when her smaller draft has allowed her to continue operating when a steamer would be stalled for lack of water. The work on the creek tries her clutch severely, and the owners contemplate the possibility of replacing that device by electric transmission at a later date and perhaps in a new hull. The engine operation has been consistently satisfactory, and the owners are well content that the engine for their larger tug is of the same make.

With growing experience of the RUSSELL 2 the Newtown Creek Towing Company has been able to increase the gross earnings of the boat, which are considerably ahead of the same size steamers. There is apparently considerable scope for the operator to influence earnings by skill in the arrangement of schedules. This shows in the monthly statements of the boat.

The owners have their own yard for installation and maintenance of their boats. They made the installation in RUSSELL 2 and are doing the same for RUSSELL 3. During the next twelve months the performance of these boats will be eagerly watched along the New York waterfront. RUSSELL 3, in particular, will interest all other towboat owners, because she is being fitted out for a double crew and with provision for short coastwise assignments.

The 125 s.h.p. oil-engine of this little New York Harbor tug drives its propeller through a clutch but the system may later be changed to electric transmission

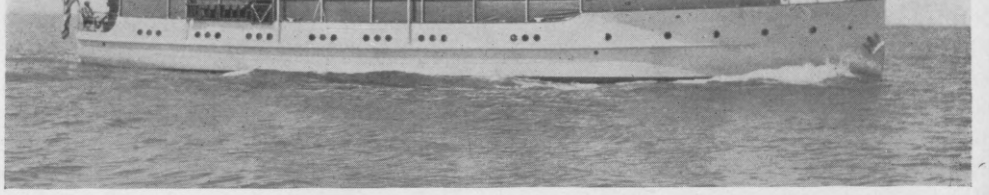
A Great Lakes Diesel Yacht

Built according to the wishes of one of the most fastidious of yachtsmen at the yard of the Defoe Boat and Motor Co., of Bay City, Mich., the REOMAR III has lately been commissioned. She is the fifth boat designed by Cox & Stevens for R. E. Olds, a yachtsman of eighteen years' experience and a connoisseur of the sport.

General dimensions of the REOMAR III are as follows:

Length	100 ft. 0 in.
Beam	18 ft. 6 in.
Draft	4 ft. 6 in.
Speed	12½ knots.

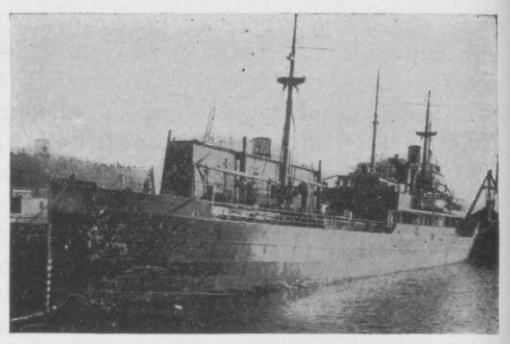
Forward of the owner's quarters, between two steel bulkheads, is the engine-room, fitted with two Mianus Diesel engines, of 120 s.h.p. each. In the same compartment are also located the electric-light generator, the ice machine, air compressor, fire pump, sanitary pump, and hot-water system. Hydraulic cylinders, for lifting the tenders out of the water on to the deck, are also located in the engine-room, but they are controlled from the bridge by means of piping and valves. Owing to the high economy of the engines, sufficient fuel to give the yacht a 2,500-mile cruising radius can be carried aboard her without any inconvenience.



Diesel propulsion for yachts has now spread to the Great Lakes. The "Reomar," a craft of this type has been placed in service

German Built Motorship Owned by Canadian Concern

An unusual type of vessel which has recently made its appearance on the Pacific Coast is the motorship PRINCIPO, built in Germany in 1920 and powered with high-speed submarine Diesel engines of the famous M.A.N. construction, and which has previously been referred to in our pages. Her gross tonnage is only 585 and she measures 182 ft. by 24 ft. beam. In spite of her small size she has all the appearance of a sea-going job.



A smaller type of merchant vessel to which high-speed submarine Diesel engines have been fitted

Originally designed to develop 550 s.h.p. each at 450 r.p.m., her engines are now operated at 275 turns and are sufficient at that speed to give the vessel a speed of 11 knots on a consumption of only 16 bbls. of fuel oil per day. An unusual feature for engines of this is the provision of a four-stage air-compressor, an expedient which undoubtedly had its origin in rendering these machines absolutely free from compressor troubles for war-time service. Considering the small quantity of air handled, the intercooling between so many stages would appear amply sufficient to keep these compressors very cool and clean-running.

Auxiliary power is furnished by a Benz Diesel running at the unusually high speed of 600 r.p.m. direct connected to a 60-kw generator and for stand-by purposes an 18-h.p. surface-ignition generating set is installed. Since the deck machinery as well as the engine-room auxiliaries are completely electrified on this ship, it is apparent that the builders of this small vessel have found this system to be the most economical.

Recently overhauled, she is now owned and operated by the Sterling Shipping Company of Vancouver, B. C.

Motorship Editorial Index for 1924

Copies are now ready and can be obtained by any subscriber without charge who will enclose 2 cents for potsage. Price to non-subscribers 25 cents.

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A Course of Instruction on Oil Engines

Each Month MOTORSHIP *Will Make Available to Its Readers the Material Used by J. Kuttner, Assistant Editor, in the Courses Being Given by Him on Diesel and Oil Engines at the Brooklyn Polytechnic Institute*

AN unusually hearty response met the opening of the course on "Diesel and Oil Engines" which was begun at the Polytechnic Institute, 99 Livingston St., Brooklyn, on October 3rd of last year. Whereas an enrollment of between 25 and 50 had been originally expected, the number of students now taking the course exceeds 150. Twenty two-hour lectures are being given on Friday evenings at 7:30 P. M., as announced in MOTORSHIP last September, and it is expected that the course will be completed near the beginning of April of this year.

So insistent has been the demand on the part of the students that notes of the lectures be made available to them that the decision has been reached to publish them serially in MOTORSHIP and to collect them in the form of a text-book to be published at the end of the series. Because of the great value arising out of the direct contact between the instructor and the students, it is not expected that the published material will be in any sense a substitute for the course; systematic instruction can be gleaned from text-books, no matter how excellent, only by the gifted few.

The course will be repeated next Fall and plans are being made to increase its scope and thoroughness.

Credit is due to the Institute authorities and particularly to Professor E. F. Church, Jr., head of the Mechanical Engineering Department, for seeing the sign of the times and for recognizing the need for training in oil engine work. They correctly interpret the statistics of oil engine manufacturing and applications, which are eclipsing previous records.

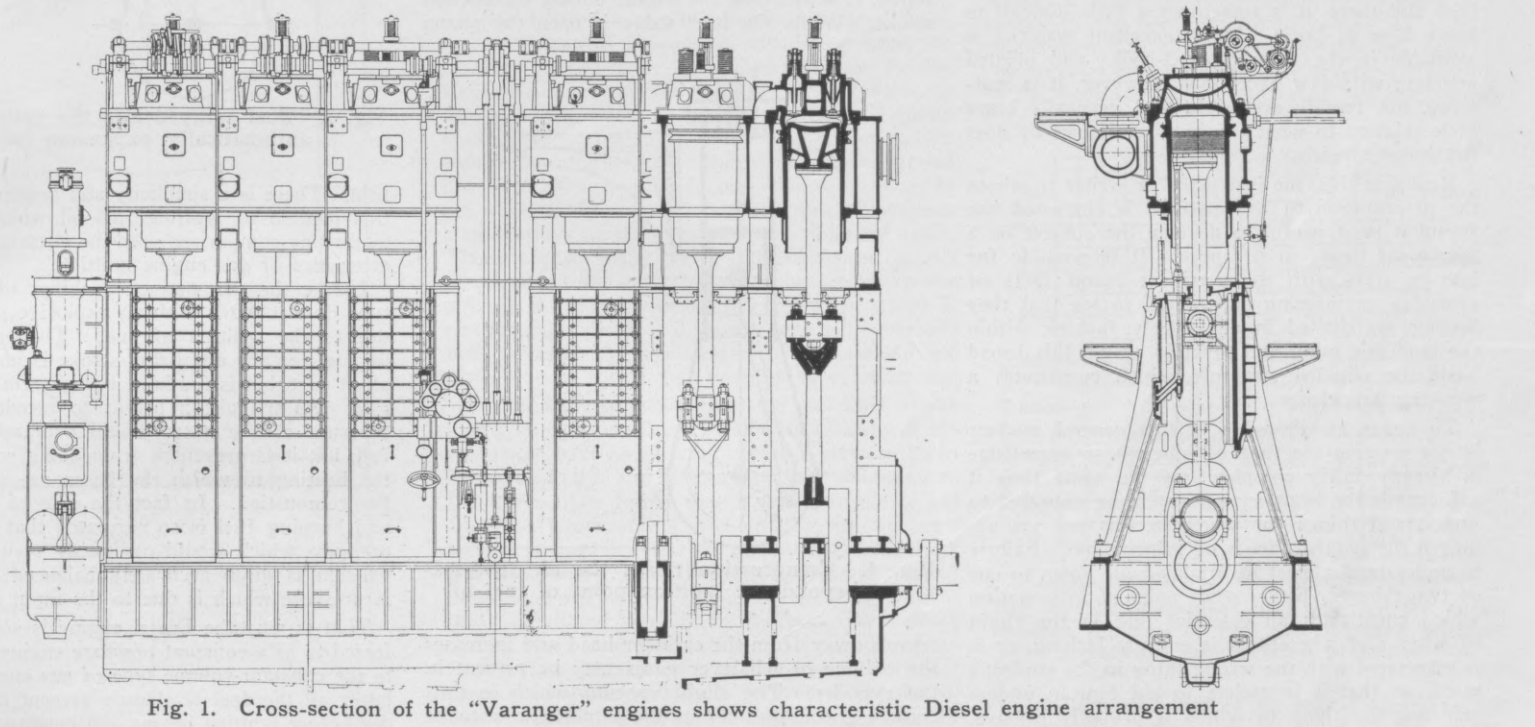

Fig. 1. Cross-section of the "Varanger" engines shows characteristic Diesel engine arrangement

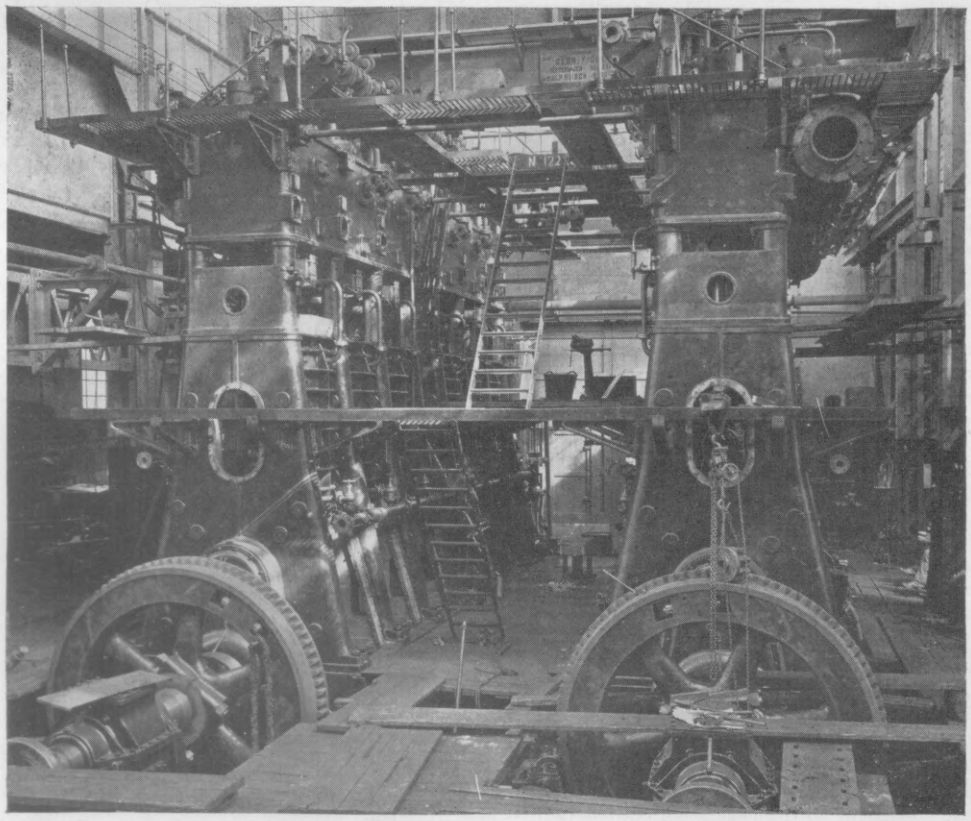

Fig. 2. Shop view of 2,125-i.h.p. engines installed in motor tanker "Varanger" of 18,315 tons' displacement

Introduction

A broad basis and a sound foundation is assured for the phenomenal expansion of the oil-engine industry. As a prime mover which produces from a pound of oil the same amount of mechanical work which can ordinarily be realized from four pounds of coal, the Diesel engine will occupy a more and more invincible economic position as the earth's coal supplies approach exhaustion faster than its mineral oil reserves.

Powerful incentives have therefore backed up the development of the oil engine and the conquest of the technical difficulties with which its manufacture and operation have been bound up in the past. Many million dollars' worth of capital have been attracted to oil engine undertakings and out of the sum total of engineering and commercial effort which has thus been engaged there has been developed a prime mover which is swiftly displacing established forms of power machinery from larger and larger numbers of installations.

Engineers well-grounded in the operation, installation, manufacture, and design of oil engines are being demanded in increasing numbers to meet the demands of this industry. The essential characteristics of internal combustion engines using heavy oil as fuel differ so much from those of other prime movers that proficiency with the latter will not alone insure success in dealing with

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oil engines. Although much information about steam and gas engines can be profitably applied to oil engine work, specialized study and training and above all the ability to handle problems from the oil engine point of view are essential to success with this newer type of machinery.

Special emphasis is laid on operation and maintenance, but since it is felt that a knowledge of how and why a given type of engine came into being is indispensable for a well-grounded operating knowledge, these matters are treated in detail. The scientific and mathematical aspects of oil engine construction are developed with a view to making the operator able to think for himself and advance far enough to prepare those students who wish it for manufacturing and designing work. The subject is treated in far greater detail than is necessary for passing the examinations for certificates to operate motor vessels under the Steamboat Inspection Service.

For those who wish to study the subject from the ground up, as well as for those who have picked up considerable amounts of information here and there, it is sometimes a little difficult to know how to begin. Much excellent material is available in the form of text-books and printed articles; with few exceptions, however, it is scattered, not readily accessible, and generally bears little relation to what the inquirer knows or does not know already.

Realizing this, the instructor or writer to whom the presentation of the material is entrusted has found it most useful to develop the subject on a pyramidal basis, so to speak. It is possible for him to start with the pertinent broad facts of everyday engineering experience, to see that they become marshalled in an orderly fashion within the student's mind and to build up on this broad basis the detailed structure which constitutes a working knowledge.

To order his thoughts in this general manner is not wasting the time of him whose knowledge is already fairly complete; at the same time it safeguards the beginner against being expected to understand things for which he has not yet acquired the requisite basis of information. Failure to understand almost invariably boils down to one of two things: Either some point of information which constitutes an essential link in the chain of whys and wherefores is entirely lacking, or it is associated with the wrong thing in the student's mind, so that it is useless to aid him in understanding the thing to which it properly belongs.

It is not proposed, therefore, to confine this course merely to furnishing facts to the students; as a matter of fact, a good many are in possession of them already and to that extent a certain amount of duplication is inevitable. An effort will rather be made to insure that the facts become properly co-ordinated. Things well understood are things correctly associated. Knowledge as an organic whole taxes the student's memory far less than knowledge in the form of unrelated items; it is much more likely, also, to serve him as a practical tool requiring a minimum of conscious effort to use it.

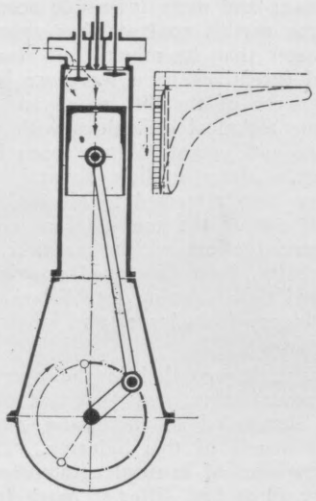

Fig. 3. On the suction stroke fresh air enters the cylinder

In a sense, the course is an elementary one; on the other hand those who are already well-informed on the subject of oil engines may conceivably benefit from a systematization of their knowledge.

A Preliminary Survey

In the broad general class of internal combustion engines the high compression machine using heavy oil as fuel occupies a place by itself. It is distinguished, above all things, by the fact that its cylinders are supplied with fresh air only, unmixed with combustibles. Heat developed by the compression of the fresh air charge is depended upon to produce ignition, and sources of heat other than the compression play an unimportant part in initiating combustion.

Without attempting at this stage to deal fully with the various phases of combustion that occur in high-compression engines, a brief review of the general cycle may properly be made the starting point of the course. Fresh air only, as has been stated, is drawn into the engine during the suction stroke. While the inlet valve is open the piston

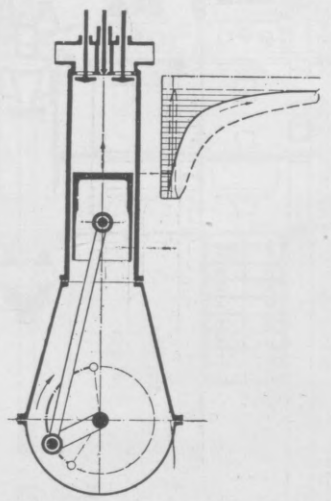

Fig. 4. Compression raises the air temperature beyond the ignition point of fuel oil

travels away from the cylinder head and increases the volume of whatever gases may be present in the cylinder. The slight vaccum which is thus created encourages air at the intake elbow to be pushed in by atmospheric pressure until the piston has reached the end of its travel. After the completion of this, the *suction stroke,* the inlet valve is returned to its seat and the piston begins to return towards the cylinder head with all valves closed. Slightly more than 180° of crank travel are consumed, while the cam, driven at half-speed through suitable gearing, traverses half that many degrees. Flywheel inertia keeps the engine moving and although its speed is reduced, the actual slowing down is so slight that it cannot be detected by ordinary methods.

As the piston again approaches the cylinder head, the volume of the entrapped gases is reduced while their pressure and temperature are raised. This is the *compression* stroke; like the preceding one it is accompanied by a tendency on the part of the engine to slow down. Because of the great mass of metal contained in the flywheel, the compression and frictional resistance are in this case also overcome without noticeable speed reduction. By the time the piston has reached the head end dead center, entire amount of the air has been forced into the clearance or combustion space, where it occupies slightly less than 1/13 of the volume which it had at the beginning of compression.

This sudden reduction in the volume of the air raises its pressure to 450 lbs. per sq. inch or more, while the temperature which is attained by it exceeds 800° F. and may reach 1,000°. It is important to bear in mind that this temperature is produced solely by compression and is established without the combustion of fuel.

At the moment of highest compression, which also corresponds to the sparking of a gas engine, a spray of fuel is projected into the highly compressed air. The latter is practically incandescent and if it could be observed would perhaps be colored cherry red by particles floating in it. Fuel oil will readily flash into flame when squirted against red-hot iron, since its flash-point is far below that which corresponds to a cherry red

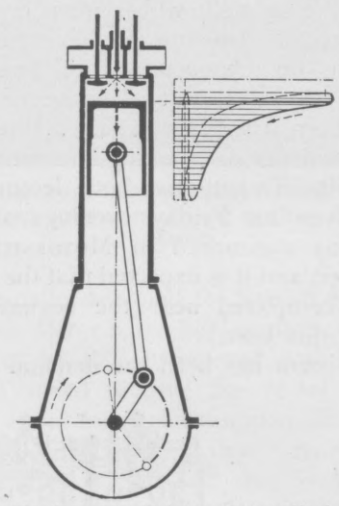

Fig. 5. Fuel sprayed into the cylinder ignites automatically, expansion follows

heat. There is a simplicity and positiveness about this method of igniting fuel oil which makes an interesting comparison with the electric spark characteristics of gas engine ignition.

Unlike the gas engine, machines of the Diesel type do not work with an explosive pressure rise due to the ignition of fuel. The entire charge of fuel for any one firing stroke is not introduced all at once, but is fed in at a predetermined gradual rate. As the piston begins to recede again, the pressure of the gases would ordinarily begin to fall, but it is prevented from doing so because of the heating to which the gases are subjected by the combustion. In fact the rate of introducing and burning fuel is so regulated that the drop in pressure which would ordinarily result from expansion is quite accurately balanced by the rise in pressure which is due to the input of heat.

That is why the Diesel engine is sometimes referred to as a constant pressure engine, in contrast to the constant-volume type of gas engine. In the latter all the fuel is already present in the cylinder before ignition begins and combustion, once it is started, proceeds so rapidly that the piston hardly has an opportunity to get off the dead center.

In the Diesel engine combustion ceases with a fair degree of promptness after the last of the fuel charge has entered the cylinder. The flame is then extinguished and during the remainder of the *expansion* stroke the pressure and temperature of the gases fall rapidly while a substantial part of the heat energy is converted into the mechanical work of driving the piston. During this stroke, incidentally, the flywheel is speeded-up enough to compensate for all the speed reduction

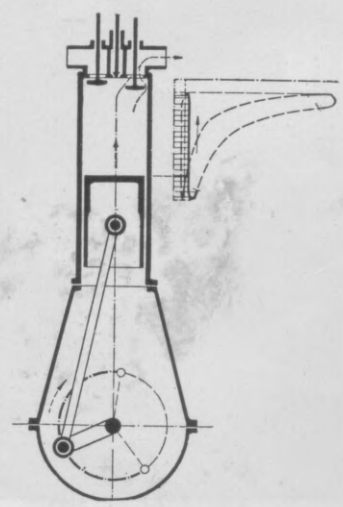

Fig. 6. Spent gases are exhausted from the cylinder

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which it experiences during the remaining strokes.

Shortly before the end of the expansion stroke, when the pressure and temperature of the gases have been materially reduced, the exhaust valve is thrust open and escape to the atmosphere is made possible. The piston is practically at the crank-end dead center at the moment when pressure equalization with the atmosphere is complete; spent gases still fill the cylinder and they are expelled by the piston on its next stroke while the appropriate valve remains open during the *exhaust* stroke.

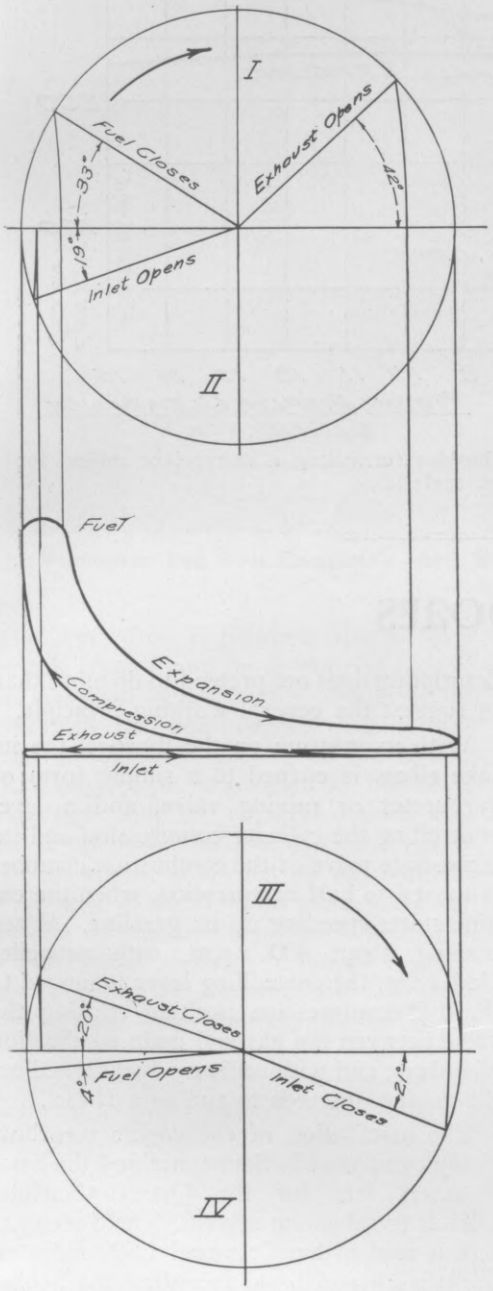

Fig 7. How the valve timing of a Diesel engine works out in practice

The process thus outlined is known as the *four-stroke cycle* and does not differ from the four-stroke gas engine cycle except with respect to the introduction and ignition of the fuel.

Temperatures and Pressures

That temperatures sufficient for reliably producing ignition may be produced by compression alone is apparent from the curves showing how the temperature of air rises when it is rapidly compressed. Compression means primarily reduction in volume; it is accompanied simultaneously by a rise in temperature and in pressure. Since ignition depends on it, high temperature is essential to the running of the engine; it is conducive, also, to the most efficient utilization of the heat subsequently liberated by the combustion of the fuel. The attendant high pressure, of course, is a disadvantage as far as the mechanical structure of the engine is concerned; yet the technical difficulties arising out of it have not been sufficient to prevent the engines in which they occur from being phenomenally successful.

An inspection of the temperature-volume curves shows that a rapid reduction in volume of a given quantity of air to about 1/13 or 1/14 of that which it had at the beginning of compression from atmospheric pressure and temperature of 60° F. is sufficient to raise its final temperature to above 800° F. Since the flash-point of the fuel commonly used is rarely above 250° F., the assurance that it will fire automatically is roughly threefold.

According to the temperature condition of the cylinder in which the compressing is done, the heat liberated in the air is somewhat increased or diminished and its pressure and temperature are correspondingly affected. During those parts of the compression stroke over which the cylinder metal is warmer than the air, the latter is of course heated more than it would be by compression alone; and when the air has attained a temperature higher than that of the confining metal, its temperature and pressure energy is somewhat diminished as the result of heat transfer.

Viewed from a purely practical point of view, the mathematical process of calculating what the pressure would have been had the air yielded 100% of its compressive heat to the walls, is hardly more than a mental exercise. Equally futile is the calculation of the temperature which would be attained if compression were carried out in a 100% non-conducting cylinder. Even in the analysis of indicator cards from oil engines computations of this nature are of doubtful value. There are so many local and accidental factors which affect the interchange of heat between the air and the metal that the attempt to fix them in mathematical symbols does not meet with unqualified success. As a standard of comparison the mathematical forms may possibly be of some use.

As far as is known, neither the invention of the high-compression oil engine nor its subsequent development have hinged on difference between high-conductive and low-conductive compression. Designers have found that it was possible to get adequate temperatures without the use of pressures causing insuperable mechanical difficulties. Operators know, also, that it is sometimes difficult to start an engine if water at the freezing point is being circulated through its jackets. Wear-down of the main and connecting-rod bearings of an engine have been known to increase the cylinder clearance volume sufficiently to prevent the attainment of suitable pressures; on the other hand, the compression of air initially heated by contact with hot valves or a near-incandescent piston crown has been known to result in end-temperatures higher than those which might be normally expected.

Some general figures as to what the compression pressures and temperatures of an oil engine are likely to be are naturally good to have in mind. For that purpose the figures already discussed in connection with the curves are sufficiently accurate. With a volume-ratio of compression equal to 1/13 or 1/14 end pressures varying between 430 and 480 lbs. per sq. in. are obtained and they are accompanied by the attainment of temperatures varying between 800° and 1,200° F.

Basis of the Cycle

No such pressures and temperatures are used in gas or gasoline engines of the general type which the rapid adoption of the automobile has made familiar to almost every one. Owing to the gaseous nature of the fuel used and its consequent introduction along with the fresh air supplied to the cylinder, high pressures would produce pre-ignition, a phenomenon which sets a rigid limitation on the compression pressures which can be employed.

Aside from questions of ignition or pre-ignition, high compression is desirable for the attainment of efficiency, up to the point where mechanical frictional losses in the engine begin to be a deciding factor. Efforts have, in fact, been made to circumvent the pre-ignition difficulty in gas engines by such expedients as the studied elimination of all parts from the cylinders and heads which through inadequate water-cooling tend to encourage pre-ignition. In one case a compression higher than 400 lbs. per sq. in. was used and the automatic firing of the gas and air mixture during the compression stroke was prevented by the use of a water spray. Despite the abstraction of heat due to the vaporization of the water, the over-all efficiency of the water-injection engine was higher by a considerable margin than that of the normal gas engine.

Not much reflection is required to show that the slowing down of the engine due to compression is practically counterbalanced by the speeding-up which results from re-expansion. Whether or not fuel is burned in the air after compression has been completed, almost the same amount of work as that which was necessary to do the compressing is given back to the piston. It is easy to keep a hand-cranked automobile engine spinning after it has once been set in motion.

There is ample scientific evidence to show that the elevation of temperature which results from compression is conducive to high efficiency. Heat supplied by the combustion of the fuel does two things: it raises the temperature of the gases and results in the performance of work. If a high temperature has already been established, say, by compression, a correspondingly greater proportion of the fuel-heat will be converted into mechanical energy.

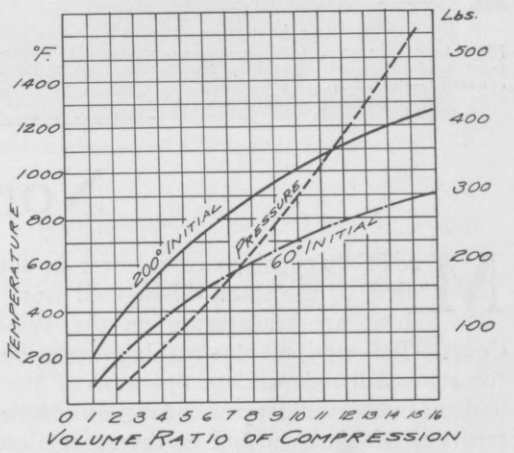

Fig. 8. Temperatures high enough for spontaneous ignition of fuel are obtained without excessive compression pressures

How the efficiency of an engine varies as the compression is increased is shown in the curves, Fig. 8. It will be seen that the greatest gain occurs at the low values. Doubling the compression from a 3½:1 volume ratio to 7:1 yields a far higher gain in efficiency than does the increase from 7½:1 to 15:1.

It is necessary to bear in mind just what is meant by efficiency. As the fuel burns and maintains the pressure on the piston, not all the heat units which are liberated become transformed into work. The ratio between the total work capacity represented by the chemical energy in the fuel and the number of foot pounds actually shown to have been performed by the engine indicator is calld the *thermal* efficiency of the engine. Before the work done on the piston by the expanding gases can be made available on the engine shaft, the internal frictional resistances of the engine parts must be overcome. The higher the compression the more friction there will naturally be. It is customary to define *mechanical* efficiency as the ratio between the indicated power of an engine and the power which is actually realized on the shaft. As compression is increased, mechanical efficiency falls off because of the greater frictional load which must be carried.

Increasing the compression beyond the 14:1 ratio not only fails to yield a worth-while gain in thermal efficiency, but also lowers the mechanical efficiency to such an extent that it neutralizes the slight thermal gain which has been secured. The compression volume ratio of greatest over-all advantage lies between 13 and 14 and it may be regarded as a fortunate coincidence that the temperatures associated with these figures are safely higher than those required for the spontaneous ignition of the fuel.

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But the use of high compression has a triple justification. 1. The best combination of thermal and mechanical efficiency is obtained. 2. Igniting devices can be dispensed with. 3. The use of cheap, essentially non-volatile fuels is made possible.

There is particular significance in the last-named point. As yet there is no commercially practicable method for converting the cheaper fuel oils into a gas sufficiently homogeneous and stable to permit of its being used in ordinary gas engines. Coal can be so converted by means of the gas producer, but the complications and disadvantages of the process have thus far prevented a wider adaptation of it.

The high-compression oil engine comes nearest to meeting the requirements for an apparatus which can convert raw fuel into power with a minimum of intermediary processes. Gasoline for automobiles is a highly refined substance; illuminating gas for gas engines is the product of a complex coal distilling procedure. Before a steam engine is actually ready to yield power, it must also be supplied with a partial distillation product —steam. If a large Scotch boiler with its firing grate are called to mind and if the multiplicity of apparatus in the form of condensers, heaters, feed-pumps used in connection with it are visualized, it will be conceded that this point of view has a certain amount of justification.

(To be continued)

[*Our pages are opened to correspondence on this course from readers in other parts of the country, or in other countries.*—EDITOR.]

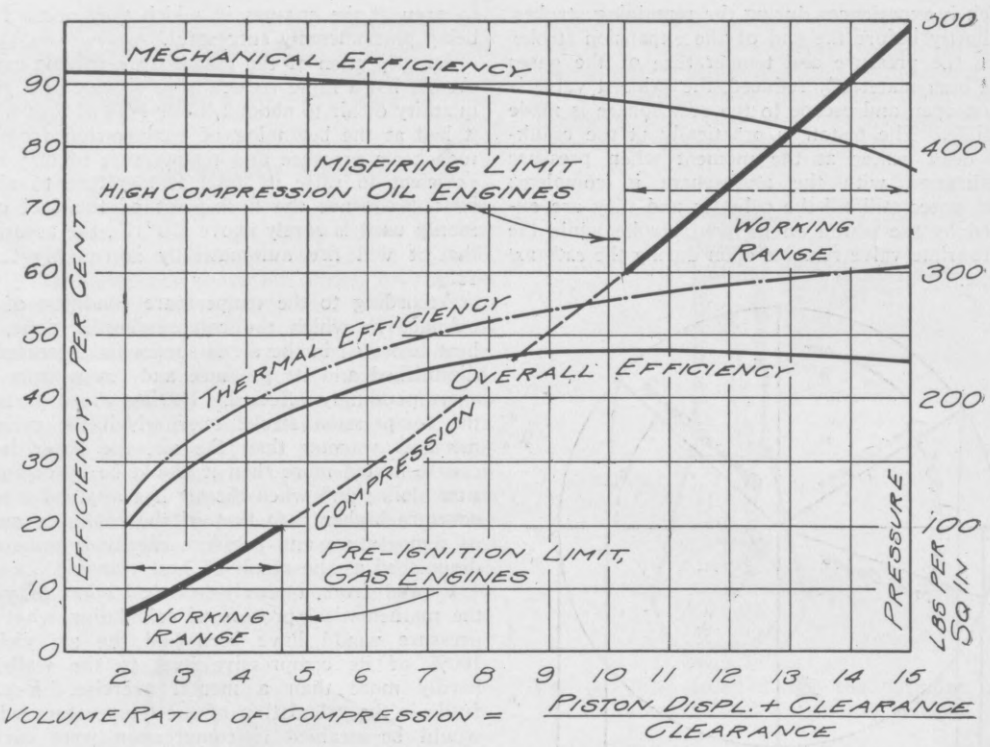


Fig. 9. High compression promotes efficiency, besides furnishing a convenient means for igniting the fuel

Northwest-Coast Workboats

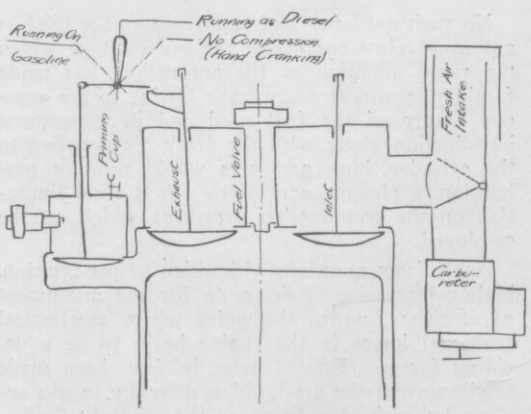
Oil-Engine Economies and Conveniences Are Actively Stimulating Production and Applications of This Useful Type of Craft

MANY happenings of interest in the field of the small oil-engined workboat are transpiring on the West Coast. This equipment is making it possible for the small independent operator of limited means to build up a towing or fishing business of his own and at the same time technical progress shows itself in many interesting innovations that are bound to receive try-outs as increasing numbers of men are beginning to turn over in their minds new ways for getting additional service from their oil-engined craft.

Gasoline-Started Baby-Diesel

E. Peterson's 42-ft. seine-boat SNOQUALMIE of Vancouver, B. C., is a small boat closely resembling Norwegian vessels currently used and has the distinction of being equipped with the smallest Diesel engine in these waters, and which is one of the few hand-started high-compression oil engines. Her power plant is a four-cycle Bukh Diesel engine of Danish origin having a 7½ inch bore and a 10¾-inch stroke normally operating on the airless-injection principle. It is rated at 17 s.h.p. and 450 r.p.m., being clutch-connected to a reversible propeller of 31½-inch diameter set at 25-inch pitch.

Instead of using compressed air for starting as in larger sizes of Diesel engines, there is a gasoline starting device, which after being thrown in speeds up the flywheel until it has sufficient momentum to start on full compression as a Diesel engine. The engine is fitted with a Bosch magneto for starting; and the gas combustion-chamber with its spark plug, is a separate space from the main combustion chamber, to which it is connected with an intermediate valve. To start the engine, the disconnecting clutch is thrown out, and a valve opened cutting out the high compression entirely. Then with the crank and flywheel free to revolve easily the engine is cranked by hand. A separate chamber containing the spark plug is separated from the main combustion space by means of a hand-controlled valve and in the separate chamber the spark-plug is also located. Opening the hand-controlled valve has the double effect of exposing the cylinder mixture to the spark plug and of changing the clearance volume and reducing the compression to a figure adapted to running on gasoline. Compression is entirely relieved, so long as the engine is being hand-cranked, by the simple expedient of holding open the exhaust valve. Our information on this device is incomplete as yet, and this



A possible arrangement of gasoline-starting high-compression oil-engine

description does not pretend to do more than to suggest the general working principle.

With momentum on the flywheel the intake elbow is opened to a simple form of carbureter or mixing valve, and a lever controlling the cylinder compression and intermediate valve of the combustion chamber is moved to half compression, when the engine starts speeding up on gasoline. When turning about 400 r.p.m. with propeller blades flat, the controlling lever is moved to the full compression position, closing the valve between the gas and main combustion chambers, and with ordinary fuel turned on, the engine proceeds to run as a Diesel.

The installation of the engine was hurriedly completed in September and the SNOQUALMIE left for the Queen Charlotte Islands to seine dog salmon. The SNOQUALMIE is said to have covered 1,600 miles on the trip up and back, including the fishing operations of about a month. During this time she consumed 225 gallons of fuel costing 7½ cents a gallon, the fuel consumption working out about a gallon an hour running at between 7 and 8 knots, or a cost of roughly a cent a mile. The catch for the trip is said to have been 75,000 dog salmon, for which a price of five to six cents apiece was being paid.

Under-Sized Foundation No Drawback

The Vancouver Tug Boat Co. has recently installed a four-cylinder four-cycle Washington-Estep Diesel engine developing 100 s.h.p. at 325 r.p.m. in the harbor tow-boat ATTA BOY, 58 feet long by 13½ ft. beam, in place of a 52-h.p. two-cylinder two-cycle oil engine with which the tug had been doing good work; but more power was required.

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Vancouver Tug Boat Company's "Atta Boy," powered with a 100-s.h.p. Washington-Estep Diesel engine, works 24 hours a day as a dredge tender

The ATTA BOY is planked with fir over bent oak frames, and on account of lack of time, and some little difficulty in altering the engine bed the new 100-h.p. engine was placed on the same seating as the former 52-h.p. engine; yet in spite of the bed being on the light side the engineer reports that there is no particular vibration felt except when the engine is opened up full with the tug running light. This Washington-Estep engine is of the airless-injection type, and has a reversing clutch. It swings a three-blade propeller 54″ diameter and 34″ pitch at 325 r.p.m. when towing, this being the speed at which the engine develops its rated horsepower. A hoisting boom is provided for handling miscellaneous supplies.

Maneuvers on Scavenging Pump

The Vancouver Tug Boat Co.'s new 75-ft. tug LAREINE of Vancouver, B.C., built by the Vancouver Shipyards Ltd. and equipped by the B. C. Equipment Co. with a four-cylinder two-cycle Polar Diesel engine of 11½″ bore and 16½″ stroke developing 220 s.h.p. at 230 r.p.m. has recently been put in commission and is working out very successfully. Her trial trip consisted of a run of several hundred miles up the coast with a tow of scows during which she turned her three-blade propeller of 78″ diameter and 60″ pitch at 225 r.p.m. Since then she has been working on a contract towing out to the West Coast of Vancouver Island. The main engine is direct reversible. Two extra cylinders with cranks 90° apart on the main shaft in addition to the four working cylinders, operate as a double-acting air engine for starting or reversing; while under ordinary running conditions they work as scavengers. In connection with the large-

Gasoline is used for starting the high-compression oil engine of this seine-boat, the "Snoqualmie"

A 220-s.h.p. Polar Diesel engine, with scavenging pumps arranged to run on compressed air while starting, drives this 75-ft. tug

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Some Recent Additions to North West Coast Oil-Engined Work Boat Fleet

	Length	Power	Make of Engine	Owners
Atta Boy	58	100	Washington-Estep	Vancouver Tug Boat Co.
Pacific Foam	54	100	Fairbanks Morse	Pacific Tug & Barge Co.
Radio	55	90	Atlas Imperial	Capt. J. A. Cates
Radius	60	125	Atlas Imperial	Capt. J. A. Cates
Prospect Park	—	80	Kahlenberg	Prospect Towing & Shipping Co.
Teeshoe	56	110	Union Diesel	Powell River Co.
C. & S.	60	110	Union Diesel	Cooper & Smith Co.
Unnamed	54	100	Skandia	Dan King

diameter scavenging cylinders, low-pressure air suffices for prompt starting.

Municipal Diesel-Driven Ferry

Instructions have been issued by the municipal council of West Vancouver, B. C., to T. Halliday for drawing up plans on a new ferryboat 105 ft. over all by 18 ft. beam to be propelled by a Diesel engine. Although the exact power and make of the Diesel engine have not yet been decided upon, it is likely that around 200 s.h.p. will be required. Hitherto the Vancouver municipal ferry service has been maintained by passenger boats equipped with heavy-duty distillate burning engines. One of these boats runs on an hourly service for 18 hours throughout the year, not counting a week's lay-off for overhaul, with the result that the cost for fuel has been high.

Although a good showing as regards reliability has been made in this service by the internal-combustion engine, in the first ten years of operation the Sonrisa, an 80 ft. 80-h.p. gas-engined boat burned over a quarter of a million gallons of fuel. At 18c. per gallon the cost for this amounted to $45,000. In an equal period of time a Diesel engine burning 6-cent fuel would probably save the entire cost of the boat and engine.

North-West Coast Notes

Stone Bros. of Alberni, B. C., have purchased the passenger boat Marine Express for a mail and passenger run on Alberni Canal, west coast of Vancouver Island. They are installing a 4-cylinder two-cycle 120 s.h.p. Vickers-Petters oil-engine in place of a 100-h.p. gas engine. The Marine Express is 80 feet o.a. by 15½ feet beam.

* * *

The contract for building an oil-engined cruiser 61′ o.a. by 12′ beam for use on the British Columbia coast by the Forestry Branch of the Department of Lands has been awarded to the Prince Rupert Drydock Co. The boat is being built from plans by T. Halliday, and will be equipped with a two-cylinder two-cycle Vickers-Petter oil-engine of 10¾″ bore and 11½″ stroke, developing 54 b.h.p. at 325 r.p.m.

* * *

The Forestry Department launch Scaler, built by Martin & Knight at Vancouver, ran satisfactory trials in October. She is 42′ 6″ over all, 9 feet beam and 3 feet draft, and equipped with a 24-28 b.h.p. Petter oil-engine turning a three-blade propeller of 27″ diameter and 24″ pitch at 525 r.p.m.

W. T. Barr is rebuilding the old steam tug Takara Maru which was burned and sunk in Howe Sound early in 1924. Instead of the old steam job he is installing a twin-cylinder two-cycle 80 b.h.p. oil engine built by Steijaard en Jannette Walen of Rotterdam. This engine is said to have been one of the earliest oil engines used on this coast, but after a thorough overhauling and the addition of modern features is expected to have a good useful life before it still.

* * *

E. W. Petter, the President of the British Engineers' Association, who is a director of Vickers-Petters, and chairman of the board of Petters, Ltd., oil-engine manufacturers, made a trip across Canada recently looking over the oil-engine field in which his companies have opened several branches. He was in British Columbia during the early part of December and stated that the Pacific Coast was a revelation to him, and he was immensely pleased with the prospects.

* * *

Arnet & Berg, owners of the oil-engined halibut fishing-boat Bayview, are having a larger craft of the seine boat type built at the Beach Avenue Shipyard on False Creek, Vancouver. The new boat is to be equipped with a 65-b.h.p. Enterprise Diesel engine.

* * *

Gene Brothers of Vancouver, owners of the harbor tow-boat Reef Point are re-conditioning the schooner Emma H., 87 feet long by 22 feet beam. The Emma H. was previously operated on this coast as a halibut fisherman, and was originally built in Nova Scotia. She was equipped with a 100 h.p. heavy-duty gas engine. Gene for towing and general freighting. The new engine to be installed is a 6-cylinder two-cycle Fairbanks-Morse oil-engine of the C-O type with 8½″ bore and 10″ stroke, developing 150 s.h.p. at 400 r.p.m. This engine is of the direct reversing type.

* * *

The Vancouver Daily *Province* of November 12th comments under the head "Huge Lumber Rafts Due Here Thursday" on the abilities of the two Diesel tugs Radio and Radius of 55′ and 60′ respectively, previously referred to in this article, as follows:

"With a tow of two Davis rafts, each containing 1,250,000 feet of lumber, the tugboat Lorne is due on Thursday. This large parcel of lumber is bound to False Creek mills, and will be towed through the bridges by the Cates' towboats, Radio and Radius. Each raft is 250′ long, 90′ wide and draws 18′ of water. The operation of the two small powerful harbor tugs taking the bulky tows through the bridges will be one which will attract considerable interest among the waterfront people."

In the Davis rafts referred to the logs are made up in the form of a huge sausage, the whole being securely lashed together with heavy steel cables in order to safely make ocean passages, where a flat raft made up in the usual way for protected waters, would be almost certain to break up. The bulk of the logs brought to Vancouver are made up in flat rafts of 60′ to 80′ wide, held by broomsticks and cross swifters, and averaging 40,000 feet to the section. These small Diesel tugs take the booms from larger tugs that bring them down the coast and distribute them to the mills, sometimes handling as much as 18 to 27 sections each. They also do a lot of work handling scows.

Mortgages on Vessels and Port of Registry

Oil engines are often sold on time payment terms and a mortgage on the vessel taken as security. Consequently a recent court decision invalidating a mortgage because the craft was not owned or operated from the port of registry will be of considerable interest.

The case in question is that of the Susanna (C. C. A.—4th Circ.—Oct. 21, 1924—opinion by Judge Rose). If a vessel is owned by a New York Corporation and documented at the port of New York she loses her status as a vessel of the United States if she is sold to a Delaware corporation unless she is re-documented at a port in Delaware.

Consequently, the mortgage given by the new owner (namely a Delaware corporation) after it acquired a title recorded at New York without re-documentation is invalid, since the vessel had lost her U. S. status through failure to re-document her at Wilmington.

The decision did not turn upon the validity of the mortgage as a preferred mortgage, but held that it was invalid as either a preferred mortgage or a non-preferred mortgage, except as to people having actual notice of it because of the failure to re-document the vessel at a port in Delaware after she had been sold to the Delaware corporation.

Comments on Motorship's Conversion Supplement

Since the Special Motorship Conversion Supplement was issued in conjunction with our October issue, Motorship has received a flood of letters not only from all over the United States but from various parts of the world. Following are extracts from some of these letters.

The President has noted with the greatest care the Special copy of your publication. He is bringing this matter to the attention of the Chairman of the Shipping Board. C. B. Slemp.

Secretary to the President,
The White House,
Washington, D. C.

The Supplement to your October issue of Motorship was referred to me by President Coolidge for attention. It is gratifying to know of your appreciation of the efforts that the Board is making to develop the manufacture of internal-combustion marine engines in this country. We appreciate your co-operation in this important work for it is, undoubtedly, a vital step in the development of the American Merchant Marine.

T. V. O'Connor.

Chairman,
United States Shipping Board,
Washington, D. C.

I have read the Special Conversion Supplement with great interest and shall be pleased to pass on the publication to other interested parties.

Joseph E. Sheedy.

Vice-President,
United States Shipping Board
Emergency Fleet Corp.,
London, England.

Permit me to congratulate you on the masterly way your subject has been handled in the Conversion Supplement, and the attractive manner in which it has been presented. I sincerely hope this distribution will prove a decided stimulant to the interest in motorships. J. Harry Philbin.

Manager, Dept. of Ship Sales,
United States Shipping Board,
Emergency Fleet Corp.,
Washington, D. C.

I have read your Conversion Supplement and believe it to be of great value and request you forward me another copy.

Lieut. J. P. Compton, U.S.N.

Commanding U. S. S. T-3,
Portsmouth, N. H.

I confess I know mighty little about the conversion subject, but I am a learner.

Woodbridge N. Ferris.

United States Senate,
Washington, D. C.

We wish to congratulate you upon such a complete compilation of data as is found in the Conversion section of Motorship—data particularly valuable at the present time to those interested in motorship operation. We have secured additional copies to be placed where they will be of considerable service. A. E. Clegg.

President,
Kerr Steamship Co., Inc.,
New York, N. Y.

I appreciate the extensive manner in which you have undertaken the conversion subject, and I feel sure you have contributed generously to the advancement of the Diesel engine under the American Flag. L. C. Palmer.

President,
Fleet Corporation,
Washington, D. C.

(*Continued on page* 54)

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(*Continued from page 52*)

The Conversion Supplement to MOTORSHIP is most complete and answers every question that may be in the minds of prospective purchasers of motorships. I congratulate you upon the completeness of its get-up.

GEO. W. EDMONDS.

Chairman, Committee on Claims,
House of Representatives,
Washington, D. C.

There is much of interest and value in the Special Supplement. You are certainly to be complimented in getting out a book which will be most interesting and valuable to the motorship industry.

R. D. GATEWOOD.

Manager, Fleet Corp.,
U. S. Shipping Board,
Washington, D. C.

You are certainly to be congratulated on the two numbers of MOTORSHIP for October, which are of a particularly attractive nature.

E. P. LOVEJOY.

General Electric Co.,
Schenectady, N. Y.

I will take great pleasure in reading the October Motorship Conversion Supplement.

JOSEPH HODGSON.

Traffic Manager,
Ward Line,
New York, N. Y.

Permit me to compliment you on the magnificent volume which you have produced as a Supplement to your October number. You have supplied an amazing amount of facts in a plain and very useful form and I shall certainly keep it as a permanent work of reference.

JOHN H. NARBETH.

St. Leonards-on-Sea, Sussex.

Your Supplement is a fine piece of work. You surely are to be congratulated for it and for the whole spirit therein.

TAGE MADSEN.

Superintendent-Engineer,
Transatlantic S. S. Co.,
Gothenburg, Sweden.

I have read your Special Conversion Supplement with great interest. KYLSANT.

Chelsea House,
London, England.

Allow me to say that the way in which your Supplement was got up reflects great credit on your organization. A. S. DEBENHAM.

Asiatic Petroleum Co.,
London, England.

A very interesting and useful publication.

G. F. TWEEDY.

Managing Director, Neptune Works,
Swan, Hunter & Wigham Richardson, Ltd.,
Newcastle-on-Tyne, England.

Your Conversion Supplement deserves careful study. JAMES DENNY.

Wm. Denny & Bros.,
Dumbarton, Scotland.

Your Conversion Supplement seems to be a full and complete treatise on the subject, upon which I congratulate you. ERNEST PERMAN.

Manager,
Temple Press Ltd.,
London, England.

Your Conversion Supplement is of particular interest. The length to which your journal goes in giving useful information to the trade is worthy of great commendation and does you credit, and your descriptive articles at various times giving particulars of installation down to the smallest item of equipment with makers' names and addresses is absolutely on the right lines for genuine usefulness to your readers. It is a pity similar methods are not adopted abroad.

EDWARD T. OWEN.

Norris, Henty & Gardners, Ltd.,
London, England.

I will peruse your Conversion Supplement with much interest. K. O. KELLER.

Wm. Doxford & Sons,
Sunderland, England.

We have given a place in our library to your Conversion Supplement. D. GOEDKOOP, JR.

Kromhout Motor Works,
Amsterdam, Holland.

I have had your Conversion Supplement carefully filed for future reference.

SEYMOUR DARLINGTON.

Vickers Limited,
London, England.

I will read your Conversion Supplement with much interest. GEORGE BLACK.

Richardsons, Westgarth & Co., Ltd.,
Hartlepool, England.

The Conversion Supplement is an exceedingly interesting production. J. CARTER.

Managing-Director,
Crossley Bros. Ltd.,
Manchester, England.

Publication of this timely and interesting Supplement will arouse national interest and will greatly help to stimulate speedy fulfilment of its purpose. R. E. LOVEKIN.

R. E. Lovekin Corp.,
Philadelphia, Pa.

I find the Conversion Supplement exceedingly interesting and very nicely gotten up in every way.

ERNST HEDIN.

Götaverken,
Göteborg, Sweden.

The Supplement is indeed an excellent production both as work of reference and example of the printer's art. C. T. WILKINSON.

Gardners Ltd.,
Manchester, England.

I beg to acknowledge receipt of the Conversion Supplement. H. C. REGENBOGEN.

Technical-Director,
Krupps,
Kiel Germany.

The Conversion Supplement is of great interest to me. J. MCGOVERN.

Managing-Director,
Furness Shipbuilding Co. Ltd.,
Haverton Hill-on-Tees, England.

Your Conversion Supplement represents an enormous amount of careful work, on the assembling of which I beg to congratulate you.

CHAS. RANDOLPH SMITH.

Managing-Director,
North British Diesel Engine Works,
Glasgow, Scotland.

Your Conversion Supplement is a very valuable and important document. A. C. ROSS.

Managing-Director,
R. & W. Hawthorn, Leslie & Co.,
Newcastle-on-Tyne, England.

We look forward to perusing with pleasure copy of the Conversion Supplement just received.

THOMAS BELL.

Managing-Director,
John Brown & Co. Ltd.,
Clydebank, Scotland.

I extend to you my best thanks and compliments on your Conversion Supplement.

G. CHIESA.

Technical-Director,
FIAT Stabilimento Grand Motori,
Torino, Italy.

We have read your Conversion Supplement with great interest. W. R. SEWARD.

John I. Thornycroft & Co. Ltd.,
London, England.

I shall peruse your Conversion Supplement most carefully. JAMES RICHARDSON.

Wm. Beardmore & Co. Ltd.,
Dalmuir, Scotland.

I will read your Special Conversion Supplement with great interest. KENNETH CROSSLEY.

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